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ENGINEERING AND MINING JOURNAL-PRESS

A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

Methods of Gold Mining in Eastern Siberia

A description of the practice that has been followed in the placers of the Amur and Maritime Provinces

By A. P. Sviridoff

Equipping the "One Man" Mill

The most hopeful lines to follow in planning a small concentrating plant are discussed

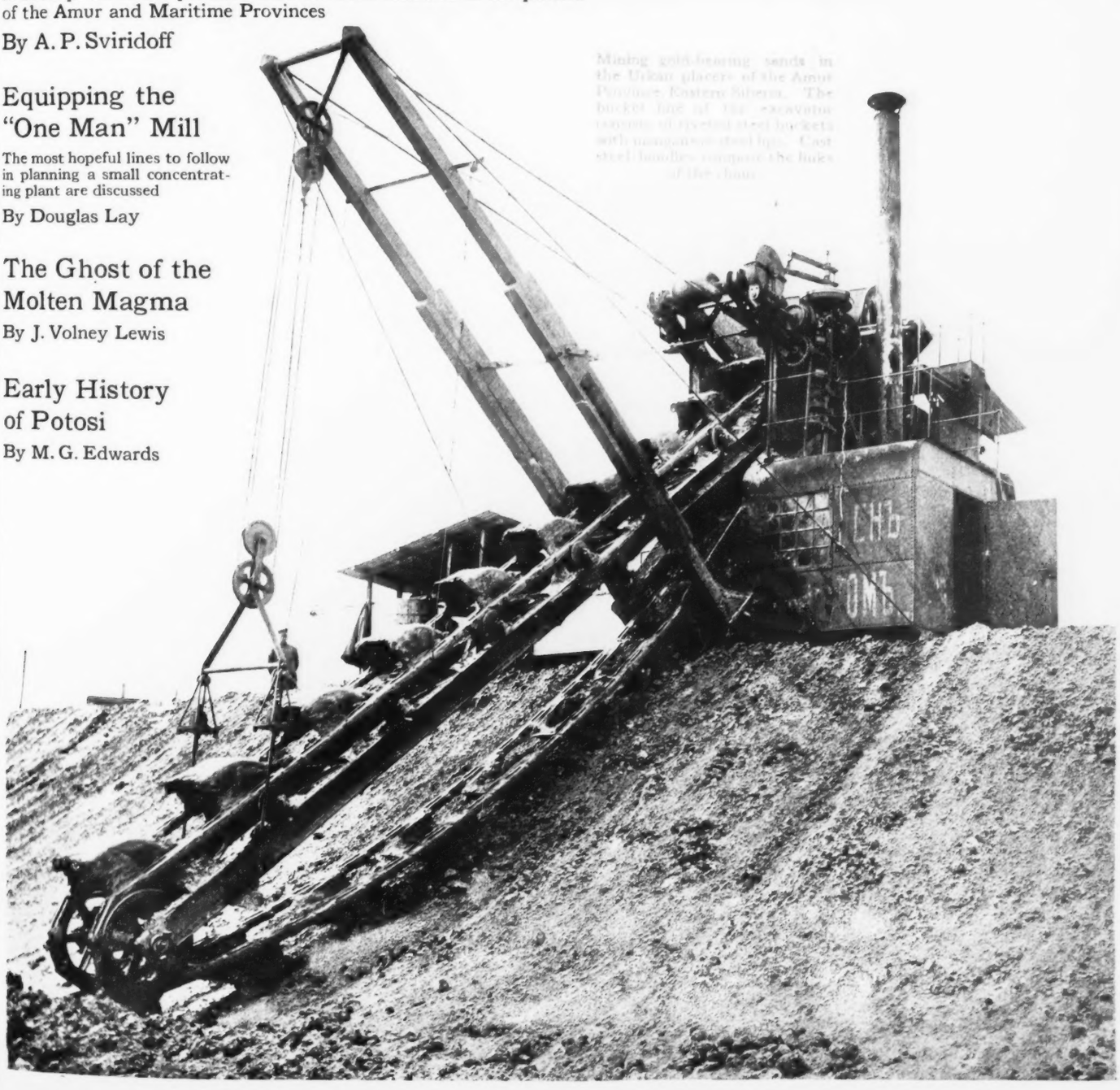
By Douglas Lay

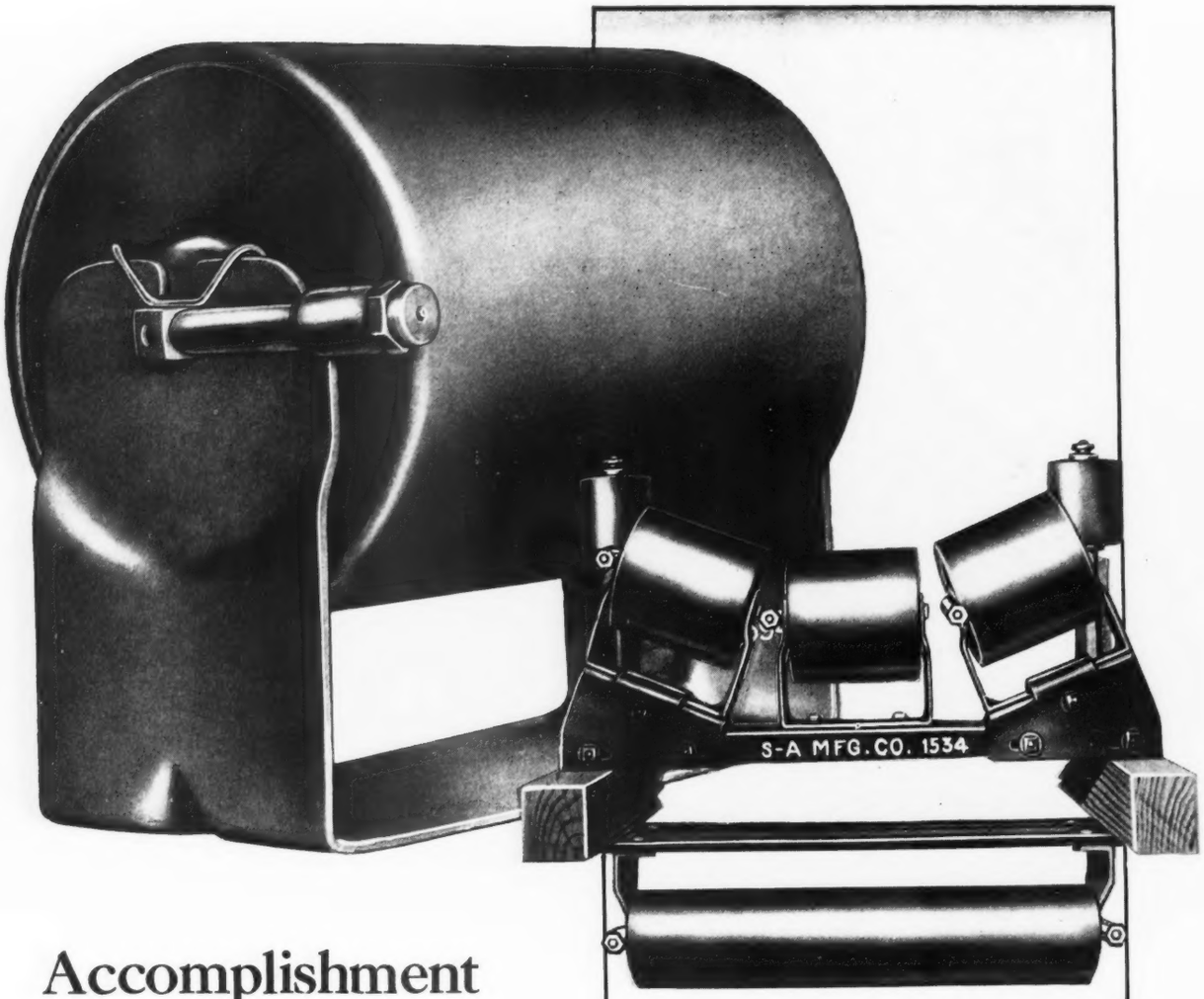
The Ghost of the Molten Magma

By J. Volney Lewis

Early History of Potosi

By M. G. Edwards





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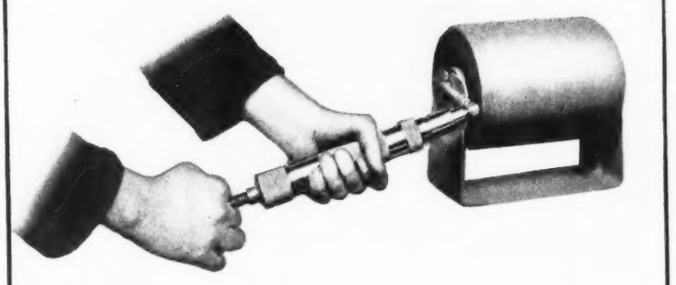

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ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

Volume 118 | New York, August 16, 1924 | *Number* 7

Silver Producers Organize

THE ONE DEFINITE RESULT of the conference of silver miners and smelters held at Salt Lake City last week is the formation of an organization called the American Silver Producers' Association. Its purpose is, briefly, the promotion and protection of the interests of all those engaged in the production of silver in the United States and elsewhere. For the time being, the project looking to the establishment of an export association has been tabled, but will be further investigated. The impression that one obtains at this distance of the convention and its work is that calm and serious deliberation brought forth the most rational result possible under the circumstances. It is to the credit of the silver mining industry and the leadership of such men as C. F. Kelley, W. M. Ferry, F. H. Brownell, Alfred Harrell, F. Y. Robertson, and others, that no radical step has been taken which would not alone subject the industry to severe criticism but would probably fail as a solution of its problems. Silver miners happily seem to realize that there are only two ways by which the price of silver can be improved, and that this principle holds true for all commodities except those under strictly monopolistic control. One method is to increase consumption and the other to decrease production. Any means which disregards this fact can give only temporary relief and may end in disaster to those trying it.

At Salt Lake City the silver miners selected the method of increasing consumption as being most helpful at present. Educational work is to be planned. In their campaign to popularize silver they will probably have little difficulty in enlisting the support of silverware manufacturers, who have made this subject a life specialty and who will be glad to have the mutual financial and moral backing of the silver mining and smelting industry.

Research work is another field for the newly formed association, but it does not appear so promising as that of increasing the use of silver in forms already available. But the main thing is that the association has been formed. With the largest and smallest factors solidly behind it, the association has made a good beginning.

Another Champion

OURS IS THE DAY of the superlative. We worship at the shrine of the champion. The principal functions of the second-raters, it seems, is to keep the leaders on their toes. Our attention is called repeatedly to the fastest train, the richest man, the fattest lady, and the cheapest automobile; to the tallest building, the longest spaghetti, the hottest day, and the best seller; to the biggest boat, the sweetest peaches, the biggest budget, and the shapeliest bathing girl. We must note the champion pugilist and the champion marble player; the home-run king, and the fastest growing cigarette.

Getting nearer home, we have the deepest mine and the tallest stack; the heaviest crusher and the lightest drill; the biggest concentrator and the lowest tails; the largest nugget and the smallest cost. With this apologia we enter a contestant for the world's title of "Biggest Producer of a Non-Ferrous Metal from a Single Group of Mines"—possibly winning thereby first place in the long-championship-name contest. The St. Joseph Lead Co. is producing about 26,000,000 lb. of lead a month from its mines in the Flat River district in Missouri, milling incidentally 13,000 tons of ore per day. The nearest approach to this 26,000,000-lb. record, we believe, was made by Anaconda in 1916, when it produced 307,395,092 lb. of copper and 20,906,439 lb. of zinc, or an average of something in excess of 25,000,000 lb. of metal per month.

The contest is open to everybody; step up and make your nominations if you have any!

Whole Time and Part Time Engineers

A NUMBER OF CONSULTING ENGINEERS have complained to our representatives in the West concerning the competition of university professors and of the engineers of the U. S. Bureau of Mines. We do not mean that they necessarily criticized the situation adversely; but they stated the circumstances as accounting to some degree for hard times for the professional consulting engineer.

As to the competition of the engineers of the U. S. Bureau of Mines, it is probable that there would be some actual criticism on the part of the average consulting engineer. The view has often been stated that it is no part of the government's function to have its engineers give that intimate and undivided service which has always been the province of private business. The Bureau of Mines has defended itself against this charge many times, and has expressed itself in agreement with the theory of conduct above outlined. Yet the recurrent complaints show that the policy of the experiment stations probably does involve infringement upon individual business and the cutting out of the professional engineer, here and there, from the work he regards as his own. The general sympathy will be with the engineer in this matter. The average taxpayer does not want his money so freely spent that government officials get down to doing individual jobs for individuals or companies.

The competition with university professors is another and more delicate problem. The general practice and the general sentiment is that the university professor has as much right to his place in the sun, in the way of private jobs and private fees, as has the man who devotes all his time to the practice—not the preaching—of mining engineering, or metallurgy, or geology. Yet the college professor has the advantage in that his chief business is teaching, while the consulting engineer's chief business is practicing. Actually, the college professor makes sorties into the field of his engineer confrère when he sees an opening, and then makes a strategic retreat to his base. He has the same advan-

tage as has a journal which is subsidized by its society, whose adventures into the field of journalism are undertaken with an assurance of safety, whatever the outcome.

In so far as the professional teacher tends to exterminate the professional engineer—if this tendency is worth noting—is there any cause to view with alarm? By whom is a consulting job best done, by an engineer who devotes all his time to practice, or by one who devotes his summer vacations only? That depends, certainly, on the individual. Some of our most notable practicing surgeons also hold chairs in schools of medicine. Nevertheless, the protection and preservation of the independent professional consulting engineer is a most desirable object; and from this point of view his problem and his interests need continued sympathetic study.

The Paper-Money Maze

SUGGESTIVE of the reduction of geologic time to seconds and of astronomic light-years to yardstick units is the most recent statement of the financial condition of the German Government, reproduced here in part as reported by that useful and accurate contemporary, the *Commercial and Financial Chronicle.* We suggest that the reader test himself out by reading the following paragraph aloud. We have not done so—nor shall we:

"The statement of the Imperial Bank of Germany, issued as of June 30, was conspicuous chiefly by reason of a huge expansion in note circulation. This amounted to 205,962,820,000,000,000,000 marks, and carried the total now outstanding to past the sextillion mark), or another new high record of 1,126,310,573,761,000,000,000 marks, as compared with 17,291,061,000,000 marks a year ago and 169,211,000,000 marks in 1922."

Gorilla Seeahtik Indians and Prospectors

A PROSPECTOR is invariably hopeful and tenaciously holds on to his claims. An empty pocketbook might cause him to abandon them, but his faith remains. Five prospectors holding claims near Spirit Lake, northeast of Kelso, Washington, have discovered a novel way to forget their claims and to save their faces in the near-by community. The story is a good one and has regaled the Northwest mightily, as the newspapers have given front-page space to it and have vied with one another in amplifying details.

According to the spokesman of these robust prospectors, more than twenty animals about seven feet tall, and weighing at least four hundred pounds, hurled rocks, some of them weighing thirty pounds, at their cabin, breaking in the roof. One of the prospectors was hit on the head by a smaller rock and knocked unconscious. The animals have the appearance of a human being, standing upright, with long arms and claw-like fingers, and black or dark brown hair that covers their faces and bodies. They run rapidly, swinging their long arms. The beasts' footprints are fourteen inches long and show only four toes of uniform length.

Regular hill billies, we would say, and sufficient excuse for the five prospectors to throw up their claims and race back to the sordid comforts of civilization. Doubt has been thrown upon the account by various investigators, but nevertheless we like the story because it indicates the resourcefulness of the prospector and affords another reason for the decadence of prospecting.

The Arctic Copper Mines

THE PAPER by George M. Douglas in our issue of July 19 describes one of the most fascinating mineral occurrences in North America—the copper deposits of the Coppermine River region, near the shores of Coronation Gulf, a bay of the Arctic Ocean. Known by hearsay from the time of Hearne's journey in 1771, they are still only dimly recognized or defined. A serious attempt to explore the region was the notable expedition of Mr. Douglas and his three or four white companions in 1911. The greater part of two seasons was spent in the region investigated. Mr. Douglas found a copper-bearing belt 16 miles wide and of unknown length, the copper occurring as disseminated flakes in basalt, as amygdaloidal copper, and as fissure veins. The Douglas expedition was followed in 1915 to 1917 by the Canadian Arctic expedition under Dr. J. J. O'Neill. Dr. O'Neill determined the Bathurst Inlet mineralized area as 50 miles long, with a maximum width of 25 miles; this area is considered distinct from the Coppermine River region explored by Mr. Douglas, and the country between has not been explored.

In these two districts the content of copper varies, as would be expected. The amygdaloidal basalt flows found in the Copper Mine Mountains by the Douglas expedition had a copper content of as high as 7 per cent, while sulphides in smaller quantities carrying as much as 40 per cent of copper were found. It is likely, moreover, that the most promising part of the region has not been explored. Taken altogether, the indications are favorable for the existence of high-grade mines, as well as larger low-grade deposits in this region. We have, therefore, it is probable, a region comparable, let us say, to the Lake Superior copper region, on the Arctic shores, unprospected and unowned. Conditions for prospecting and mining are not unfavorable, remoteness and the consequent difficulty of transportation being the chief obstacle to further progress.

It may seem strange that a region which offers such substantial promise should be treated with silence by mining capital—that another Lake Superior copper region should fail to arouse interest, even with the drawbacks stated. The real reason lies in the character which the copper-mining industry has assumed. The consumption of copper by the world is ever on the increase, and the development of large-scale copper mining at many points has put the industry on a sharply competitive basis. Copper mining has become largely a manufacturing business, much like iron mining. Costs are the factor which determines the successful and profitable copper fields. The reason that the Arctic copper regions are untouched is similar to that which accounts for the neglect of the rich and abundant iron ores of Brazil. They are remote from transportation, from coal, and from the centers of consumption. They constitute one of the world's copper reserves, of which there are probably more than we realize: they will be attacked when we run out of nearer and cheaper copper, and not before. Of what use to develop a distant field, however rich, when the costs of operation would be ruinously high compared with the existing great mines which are in operation? If the ores were gold ores or silver, instead of being copper, it would be a different story. We should then see no delay in the initiation of a rush like that which flooded the Klondike and Alaska in 1898.

Turning of the Tide

IT IS THE OPINION of the National Industrial Conference Board of New York, an important statistical organization maintained by contributions from many industries, that the business tide, which has ebbed in slight depression, has now turned, and that we may look for continued improvement. Since the general condition of health of industry, as shown by general economic conditions, is the greatest underlying factor determining the health of the mining industries, this analysis is of great interest to all our constituency.

The index of production compiled by the Federal Reserve Board for the first six months of 1924 shows an increase over that for the years 1920, 1921, and 1922; and although below that for 1923, it is pointed out that the period last year witnessed the height of the trade boom. Exports were 7.4 per cent greater than for the first six months of 1923. The report states, "The belief that business this fall will be good is quite general."

The Alchemist Dips Into High Finance

A CURRENT PRESS report gives prominence to the alleged achievement of one Professor Miethe, of Berlin, who claims to know how to turn mercury into gold. Part of the joy that might have been engendered by this performance evaporates when it is learned that the cost is around $2,000,000 per pound of gold! One of our quicksilver friends drives another nail by calling attention to the fact that quicksilver usually contains a small amount of gold. An examination of certain quicksilvers produced in California, Nevada, and Texas has shown gold to the extent of 0.000524 oz. per flask. On the basis of this proportion, somewhat less than 23,000 flasks of quicksilver would contain a pound of gold. This quantity of quicksilver would cost on the present market slightly less than $1,750,000. Thus the German scientist is well within the realm of probabilities, for after purchasing his quicksilver he would have a margin of $250,000 for cost of operations, overhead, and profit. In spite of this showing, we do not anticipate any immediate flurry in our domestic quicksilver market.

How the Engineering Institutions Entertain

A CIVIL ENGINEER visiting in England, Mr. E. J. Mehren, vice-president of the McGraw-Hill Co., Inc., writes us in part as follows:

"'They do things differently in England.' Of course they do. The customs of one land must be expected to differ from those of another. Yet I could not help using the trite expression above quoted when I attended last Tuesday evening the reception given jointly by the Institution of Civil, Mechanical and Electrical Engineers to the overseas engineers who attended the World Power Conference.

"The point of difference between their affair and ours was the combination of the cultural with the social. When our societies and their presidents receive, the diversion, besides the visiting and conversation, is dancing—which can hardly be called cultural."

The entertainment in London, he continues, included the singing of old English ballads by a sextet. There was also a demonstration of a new form of cinematograph projector used in connection with slow-moving pictures, and another of the cutting of steel under water by an oxy-acetylene flame. There was also a string band; and, to be sure, refreshments.

It is probable that Mr. Mehren witnessed an extra effort of hospitality. None the less, we are impelled to reflect on the character of entertainments so often put forward at meetings of engineers in the United States, and to wonder whether such entertainments could be more cultural, and still survive. The pulling of a rabbit out of a hat—the perpetration of a mossy double-entendre—are reminiscent of extreme boyhood, a condition which, prolonged into manhood, the scientists have dubbed moronic. It would be interesting to lead a blindfolded observer into the hall on one of these occasions, and after he had listened to the program, ask him to guess whether he was present at a gathering of engineers or barbers. Is it, then, that we do not enjoy the program at the smokers? Rather.

England's Gold Supply and the Pound Sterling

WHILE THE GOLD STANDARD should be adopted by England and as soon as possible by all the other countries of the world; and while we cannot expect stable prosperity as long as fiat money or meagerly supported paper currency are used in a considerable portion of the world's business transactions, yet the proposal will not be so welcome to the gold miners in many countries as it will be to the miners of other metals and minerals.

Brokers and statesmen in England are debating the question whether the pound sterling should not be boosted to par, and there maintained, thus putting England on a gold basis only. The gold-mining industry of the British Empire will oppose this otherwise desirable move, for sufficient reasons. South Africa, the greatest gold producer among the dominions, has had much prosperity and vast profits through the depreciated pound. The miners of that country pay for labor and supplies in pounds, and sell their gold for dollars, thus obtaining more sterling cash for their gold than would be the case were the pound at par, this margin constituting the so-called and falsely-called premium. This "premium," or margin of profit solely due to the depreciated pound, is, roughly speaking, about 10 per cent. Consequently, were it cut out by a raising of the value of the pound to par, mines operating at a present profit margin of less than 10 per cent would have to close down. In addition to the probable shutdown of this group, the mines now operating at a profit of over 10 per cent would have their profits cut by about 10 per cent of the total output.

Nevertheless, the situation is like that where a malady exists which calls for a painful operation. This means a shock and a long period of convalescence, but it is necessary if the patient is to survive and compete with healthy men. Fictitious prosperity has many times been founded on inflated and even worthless currency, as in the case of German business, which was done on a falling mark, whereby supplies were purchased in other countries with marks at a relatively higher quotation, and labor was paid later at home with marks at a relatively lower level, while the goods were sold abroad. Similarly, France has faced with perturbation the too rapid rise of the franc, because her manufacturers would pay a constantly increased labor cost, on a constantly higher scale than the receipts for the sale of merchandise abroad. In the case of Germany the move to return to the gold status after the "flight of the mark" has resulted in widespread and ruthless ruin consciencelessly applied; but in England the pound is not so far below parity but what its restoration can be sustained without this evil result.

England Five Years After the Peace

By E. J. Mehren
Vice-President, McGraw-Hill Co.

The war is past history in America, but current history in Great Britain.

So, indeed, it seems after spending a week in Britain's capital, conversing with her men of affairs and listening to addresses by her business leaders and statesmen. True, there are war scars in the United States, scars that will never be erased. We are mindful of the men who died in the great struggle; we have great numbers of disabled veterans. On the financial side we still have, and will have for many years, a war-swollen budget and correspondingly increased income taxes. But, by and large, the war shadow has thinned out. In the last two years we have had "good times." Our war-time income tax rates have been twice reduced. Certainly the way is not blocked by serious obstacles. The difficulties we foresee are merely the fluctuations which, except for the "panic years," one might say are normal to business.

Not so with Britain. The war is only a yesterday with her, and the consequences are still sharp upon her. I do not mean that she is discouraged; that word has no place in the British vocabulary; nor has the state of mind it indicates any place in British consciousness. But the burdens that weigh her, the obstacles still to be overcome, are fully appreciated and are a stock subject of discussion with all her thinking men.

To enumerate some of the troubling factors:

1. There is still large unemployment—though the amount is lessening.

2. There is marked depression in the "engineering trades," as they are called here—shipbuilding, machine tool building, and the metal fabricating industries generally. In construction there are few large projects in hand, though there are a few that, after long delay, now seem likely to be taken in hand.

3. A new housing bill, that will again dip heavily into the national and into local government treasuries—and increase, accordingly, national and local tax burdens—is before Parliament.

4. The income tax rate on even small incomes is 4 shillings 6 pence per pound sterling, or 22½ per cent. The super-taxes are very heavy.

5. The Continental problem is acute and the consequent uncertainty, the upset exchanges, the diminished purchasing power, curtail British export markets.

6. Finally, the never-ending exchange of views, with their Continental war Allies, on German reparation, keeps before the British people constantly the fact that peace, though declared five years ago, is not yet here. There is cessation of military activity; there is not that accord which is peace in actuality.

That the consciousness of the international element in these difficulties is ever present with the thinking Britisher was strikingly demonstrated at the great advertising convention held here (London), at the British Empire Exhibition, recently. There were delegates from every country, though the United States sent the largest representation, 1,700 (including the ladies). To this great convention, man after man emphasized the distressed position of Europe and expressed the hope that out of the international discussions now under way in London, and participated in by the United States, there may come that peaceful adjustment for which Europe has been longing since that wonderful Nov. 11, 1918. Winston Churchill, Sir Robert Horne, J. H. Thomas, Colonial Secretary, and Lord Burnham, in particular, made this an important feature of their addresses. Every other speaker from the British Isles made some reference to the unfortunate international situation, and its effect on British industry, on British trade, and on British social and political conditions.

E. J. Mehren

Social Conditions

In private conversation one gets an even more serious picture of England's difficulties, for there the talk turns to social conditions. Briefly, the burden of these conversations can be reduced to just this: that the altruistic promises of war times and the coddling of politicians have taken from the mass of British workers a sense of responsibility for their own welfare and led them to expect the government to take care of them. Thrice, indeed, was the statement made to me, and in separate conversations, that there was a growing opinion, fostered by socialist agitators and politicians, that if the people would have the babies the government would do all else.

Such an attitude, of course, leads, and has led, to shiftlessness, inefficiency when at work, failure to provide for the rainy day—in a word, all of the economic vices of a dependent, spineless people.

The worst of the difficulty is that no one with whom I have spoken about this attitude of the people seems to have any hope for early improvement. The politician—not the statesman—is the ruler of the day, and, as with us, he does not hesitate to sell the public treasury in order to advance his personal interests.

Withal, though, it should be repeated that the Englishman is not discouraged. He has lived through a lot. He hopes that he will live through this trying period, and that a better day will come.

His way is not our way. We would think that his more or less complacent attitude might be fatal. He believes that the situation will turn out all right; we would fear that it would turn out all wrong unless vigorously handled. (One recalls our Unemployment Conference of some years ago.) We, I hope, would turn, so long as possible, to private measures of relief. The British have turned to the Government. The difficulties, of course, were very great; the amount of unemployment, for example, was quite large. Possibly with similar conditions we would have been forced to a similar solution, but I am inclined to believe that the British tap the national treasury with less hesitation than we. The actual war, let us recall in possible explanation, lasted twice as long for them as for us.

But though our methods might differ from those of the British, we cannot withhold our admiration of their sterling qualities. Similar conditions would put us in a panicky condition. They go on hanging out their sign "business as usual," confident that eventually all will be well.

Looking back on their long and brilliant history, we, too, can feel confident that somehow the Briton will come out on top. Trial and difficulty develop stamina and character. They are developing them right now in business circles. In the wage-earning classes the tendency is in the opposite direction. Eventually, under the example of conscientious leaders, even that tide should change.

Equipping the "One-man" Mill

Some Sacrifice of Metallurgical Efficiency Often Advisable in Small Concentrating Plants —Mistakes Usually Made in Following Implicitly Practice of Large Producers

By Douglas Lay
Mining and Metallurgical Engineer, Vancouver, B. C.

SMALL concentrating plants, with a capacity of 10 to 100 tons and ordinarily requiring only one man for supervision, are of wide interest, being adaptable to the needs of the small mine, or to use for pilot or experimental purposes by the large producer. Such a mill was shown on page 18 of the Jan. 19 issue of the *Mining Journal-Press* and on page 23 of the March 15 issue. Now, it is paradoxical but true, broadly speaking, to state that it is possible to design a simpler "one-man" plant for a more or less complex ore than it is for an ore readily amenable to gravity water concentration. For example, with a material consisting of a fairly coarse aggregate of galena and blende in a quartzose gangue, it would be a violation of elementary milling principles to treat so simple an ore in a "one-man" plant such as those above mentioned. On the other hand, a simple plant might be expected to yield quite good results in the case of, say, a fine dissemination of chalcopyrite and pyrite, necessitating fine grinding and differential flotation. Nevertheless, the economics of the small plant usually necessitates and justifies the violation of some mechanical and metallurgical principles, which would be strictly adhered to in large plants, notwithstanding the fact that in both types of plant the maximum profit should be the sole end in view. With the small plant, however, it does not by any means follow that the highest metallurgical recovery implies the maximum profit.

In view of the fact that there is certainly a field for the "one-man" type of mill, having the same importance in the ore-dressing sphere that the portable air compressor has in the mining sphere, I venture to present my ideas on the subject.

Although it is obviously impossible to specify the procedure to be followed without exact knowledge of the nature of the ore, it is possible to indicate broadly the most hopeful lines to follow. It will be assumed that preliminary investigation in the way of laboratory tests, considered in the light of the general economics of a "one-man" plant, justifies fine grinding of the entire feed and flotation or tabling, or both. This, whether initial fine crushing violates metallurgical principles or not.

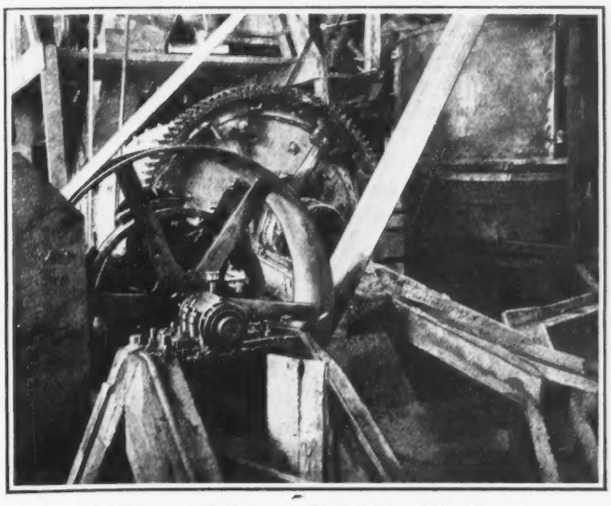
Now, the development of flotation and the ball mill undoubtedly gave rise to this idea of an extremely simple type of small plant, consisting in all essentials of a small Blake crusher for reducing the ore to between 1½ and 1 in. in size, followed by all-sliming in a ball mill, and a flotation machine for recovery. It also led to the ball mill being assigned the duty, for which it is quite unfitted, of handling coarse, hard feed. Indeed, this mistake was made with some large plants a few years ago. Excessive ball and liner consumption is inevitable if a ball mill, particularly a small one, is fed with, say, 1½-in. hard ore. It is now established practice to interpose rolls or disk crushers between Blakes or gyratories, and ball mills, the feed of the last-named being not coarser than ¾ in. even with comparatively soft ores. In the "one-man" plant, however, simplicity requires the elimination of a set of rolls between Blake and ball mill or other fine-grinding machine. It remains to decide what is the best fine-grinding device to adopt. Choice lies, without question, between a ball mill and a Chilean mill.

So far as the large ore-dressing plants are concerned, the Chilean mill has been discarded, and it requires courage to suggest that for the small plant there are many points in favor of its adoption in preference to a ball mill, if a very hard ore, or one containing gold, is to be treated. It has been my good fortune to operate a Chilean mill and a ball mill, side by side, in competition, so to speak, the feed being crushed between 1¼ and 1½ in. in size.

Reference is also invited to "A Comparative Test of the Marathon, Chilean, and Hardinge Mills" (*Transactions* of A.I.M.E., September, 1916). There, however, the feed was minus 4 mesh; that is to say, the rod and ball mills were operating under ideal conditions, and the Chilean had not the opportunity of demonstrating its points of superiority in treating coarse material.

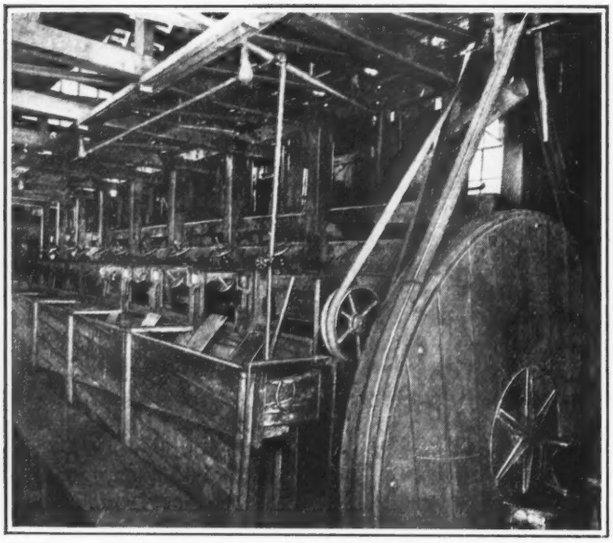
Particulars will be given here of the competition between a Chilean and ball mill mentioned above, which took place at the mill of Le Roi No. 2 in Rossland, B. C., of which company I was manager at the time.

As will be seen from the accompanying photograph, the ball mill and Chilean were set up side by side, immediately in front of the mill-feed bin. Both mills were fed by a Challenge feeder. Feed to both was precisely similar; that is, low-grade Rossland ore with gangue of augite porphyrite (one of the hardest and toughest ores on this continent), between 1 and 1½ in. in size, the product from a 12x8-in. Blake crusher. The Chilean mill was a 6-ft. Trent Monadnock, which had done duty in this plant for eighteen years, during which



Ball and Chilean mill at Le Roi No. 2

Clutch pulley of the 5 x 4-ft. ball mill is belted direct to motor pulley. Motor is placed above to economize floor space. Challenge ore feeder is belted to pinion shaft of ball mill.



M. S. flotation machine with wheel elevator

Note that slope of middling launder runs from tailing end toward feed end, to deliver middling to wheel elevator. The slope of concentrate launder is in the opposite direction. Compacting bins not shown. They are immediately on the left of the platform in front of the M. S. machine.

time it had crushed 90,000 tons of ore of the size mentioned. The ball mill was a brand new mill, size 5 ft. x 4 ft. The ball charge was three tons of 5-in. balls. The mill had the ordinary scoop feeder and was operated in open circuit. The performances of the respective mills were as follows:

Chilean Mill Performance

With ton-cap screens having a slot width of 0.05 in. (10 mesh I.M.M. standards), the following product was made:

Plus	Per Cent
10 mesh	Nil
20 mesh	2
40 mesh	6
60 mesh	3
80 mesh	6
120 mesh	12
Minus 120 mesh	71
	100

The capacity of the mill averaged at least forty-five tons per twenty-four hours from start to finish of the period of about three months, which was the life of a set of tires and die rings. When freshly tired the capacity was considerably over fifty tons per twenty-four hours. In its youth this mill was fully capable of crushing an average of fifty tons per twenty-four hours, of crusher-run down to the mesh above given. The crushing action of a Chilean takes place to a large extent regardless of the size of the screen aperture, and consequently its capacity is not affected to the extent that might at first be supposed, by enlarging or reducing the screen mesh.

Approximately three tons of water was used per ton of ore crushed. With the Rossland ores, we found that one set of tires would last two die rings. One set of tires and two die rings, or a total weight of 9,015 lb. of chrome steel wearing parts, had a life of 5,500 tons of ore crushed; that is to say, 1.64 lb. of chrome steel was consumed per ton of ore crushed. These figures apply to the lowest and hardest grade of Rossland ore. For the operation of this mill, 25 hp. sufficed.

Ball Mill Performance

The screen analysis of ball-mill discharge, operated in open circuit, was as follows:

Plus	Per Cent
10 mesh	Nil
20 mesh	5
40 mesh	20
60 mesh	4
80 mesh	11
120 mesh	12
Minus 120 mesh	48
	100

We found that the total ball consumption under such conditions was 4.5 lb. per ton of ore crushed, and liner consumption was 1.25 lb.; a total of 5.75 lb. Water required was between 0.75 and 1 ton per ton of ore crushed. The balls were of cast iron. Doubtless, forged steel balls would have resulted in an increase of grinding capacity and a decrease in ball consumption, but, on the other hand, any disadvantage the ball mill labored under in this connection was more than offset by the fact that its competitor, the Chilean, was about on its last legs, having been in service for so many years.

Now, it is a matter of supererogation to enlarge upon the many excellent qualities of the ball mill, its fool-proof characteristics, and the fact that it can be shipped in the knock-down form from one point to another and readily reassembled. Its qualities place it in a class by itself. It is not suggested that in a large plant where the ball mills receive none other than fairly fine feed there can any longer be a place for the Chilean. Nevertheless, conditions in the "one-man" plant are radically different, and there the following points in favor of the Chilean, deduced from the competition described, are well worth consideration:

1. A greater economy in power consumption.

2. A far greater economy in wearing parts. There is no getting away from the fact that with a ball mill operating on hard coarse feed, the consumption of balls is positively appalling.

3. With the Chilean, no external classifying arrangement is necessary—an excellent feature in a "one-man" plant. If a ball mill is operated in open circuit on coarse feed, any attempt to force the mill by overfeeding will result in the mill vomiting out *very* coarse discharge; in fact it will, if overloaded, cease to function as a grinding machine.

4. The Chilean mill is an excellent gold-catching machine, the mortar being a trap not only for coarse gold, but also for very fine gold, even that in intimate association with sulphides. The mortar is, of course, in a constant state of tremor, owing to the passage of the heavy rollers over the die ring, and the virtual jigging action set up causes constant settlement of gold particles in the interstices of the mortar between the inner and outer edges of the die ring and the sides of the mortar. At Le Roi No. 2 mill, in Rossland, the feed consisted of chalcopyrite and pyrrhotite, with a gangue of augite porphyrite, and assayed approximately 0.15 oz. in gold per ton and 0.5 per cent copper. The gold existed in intimate association with the sulphides, although to a great extent free in such association. Of the total gold recovered in the course of treatment 72.4 per cent was recovered in Wilfley concentrates, 16.4 per cent by flotation, and 11.2 per cent from the Chilean mortars. Note that the gold recovered accidentally, so to speak, in the Chilean mills amounted to more than 11 per cent of the total recovered. One great compensation for the somewhat laborious task of re-tiring the rollers in this particular plant was afforded by the mortar clean-up, almost invariably 50 oz. of gold contained in a very rich concentrate.

The main objection urged against the Chilean mill is on the score of the great weight of the spare parts, and the consequent loss of time involved in re-tiring rollers. An overhead crawl to handle the heavy parts is of course essential, and this should run through the side of the mill building vertically over the spot at which spares are landed, so that the latter can be picked up directly off the delivery wagon. Plenty of room should be left at this point for depositing old tire and die rings. A spare set of rollers should be kept tired, so that change of freshly tired rollers can be made speedily. A very small display of mechanical ingenuity will go far to offset the objection mentioned. It seems unnecessary to enlarge upon this point, but in the small plants that I have come across where Chileans have been in use, there has been an almost entire absence of any adequate provision for handling spare parts.

Again, a Chilean is a heavy machine—a 6-ft. mill will weigh about twenty-five tons—so it *must* have a good foundation.

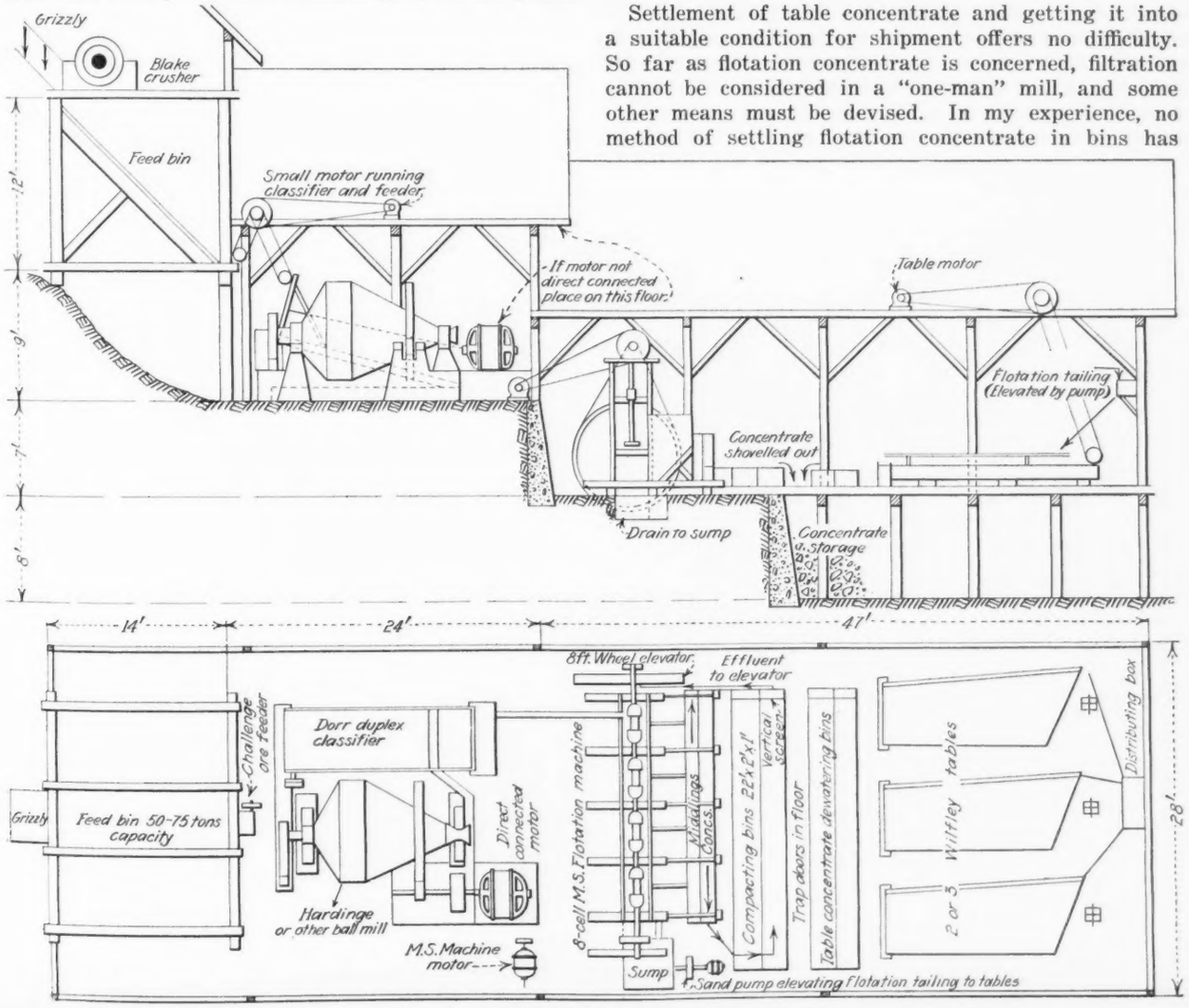
To sum up:

In the "one-man" plant, the choice lies between ball mill and Chilean. If the plant is intended to function as a pilot mill—a stepping stone to one of much larger capacity—the ball mill must be the choice. On the other hand, if no large-scale operations are likely, and if the ore is very hard and contains gold, certain points about the Chilean will show to great advantage. On the other hand, the situation of the plant may be such as to emphasize the lack of portability of the Chilean, and determine the selection of a ball mill.

Apart from any question of metallurgical efficiency, it is simpler to interpose flotation before tabling, because this eliminates dewatering table tailings prior to flotation. The most suitable water-to-solids ratio for flotation being about four to one, and Chilean mill discharge being about three of water to one of ore, and ball mill discharge being not higher than one of water to one of ore, the simple addition of water will give the necessary dilution for flotation. On the other hand, if the flow sheet calls for tabling first, table tailing will be too dilute for flotation, and the expense of a dewatering plant must be incurred. Further, if tables *follow* flotation, they serve as pilots, making plain the kind of work the flotation machine is accomplishing. There may, of course, be some special metallurgical advantage to be gained in some particular case by tabling before flotation, in which case dewatering of table tailings will be unavoidable. Should milling operations make a change from the one system to the other desirable, the installation of a slime pump will obviously accomplish the end in view without alteration of the existing plant.

Settlement of Concentrates

Settlement of table concentrate and getting it into a suitable condition for shipment offers no difficulty. So far as flotation concentrate is concerned, filtration cannot be considered in a "one-man" mill, and some other means must be devised. In my experience, no method of settling flotation concentrate in bins has



A suggested "one-man" mill

proved satisfactory. At the Le Roi No. 2 mill, in Rossland, we developed a system of compacting flotation concentrates in conjunction with an M.S. machine, which proved the acme of simplicity, and highly satisfactory even with 85 per cent of the flotation feed 120 mesh. Full details and sketches were published in the *Mining Journal-Press* of Dec. 23, 1922. The system of dealing with flotation concentrates could be followed readily, irrespective of the type of flotation machine employed. The principle is to convey the flotation froth into a long, narrow, shallow, launder-like bin. About a foot from the outlet end is placed a removable vertical screen of burlap. Just beyond the screen, in the bottom of the bin, the effluent discharges through a pipe, and is returned by wheel elevator or pump to the flotation machine.

Contrary to what might be expected, experience demonstrates that with this device the froth breaks down rapidly and settlement is effectual, especially after a bed of concentrate forms at the inlet end. The concentrate is tamped every hour or so with a wooden tamper, for two or three minutes only, and the effect of this tamping is to compact the concentrate to a rubber-like consistency, so that it can be shoveled out in chunks, which, in moisture content, compare favorably with filter cake. In this form, shipment can readily be made in bulk in gondola cars, or chunks can be sacked if conditions call for sacked shipments. If table concentrates are being made as well, it is a good idea to mix the *dewatered* table concentrate with the compacted concentrate, prior to shipment, if the plant layout permits of bins being so arranged.

The overflow water from table dewatering bins should be returned to the mill circuit, so that no unsettled concentrate can be lost. It will be noted that the effluent from the flotation concentrate compacting bins is returned to the flotation machine. The compacting bins are arranged in duplicate alongside one another, so that the contents of one may be shoveled out while the other is being filled.

The Minerals Separation type of flotation machine will be found well suited to the "one-man" mill, owing to its ability to handle coarse material. Assuming that this type of flotation machine is installed, the slope of the middling launder in front of the spitz will run from the discharge end toward the feed end, whereas the slope of the concentrate launder will run from the feed end toward the discharge end, as shown in the photograph. The compacting bins are most conveniently situated immediately in front of the M.S. machine, the outlet end of the bins being immediately opposite the wheel elevator at the feed end of the M.S. machine.

The compacting bins should be upward of 30 ft. long by 2 ft. wide, and about 1 ft. deep. The outlet must be in the *bottom*, at the discharge end, *not* at the top. If the outlet is placed at the top with the mistaken idea that, the bin being full of water, settlement will be aided, the reverse will happen; the froth will build up at the inlet end, and will overflow. The essential of success is to cause the froth to flow over a bed of compacted concentrate, which causes the froth to break down and the concentrate to settle in a striking manner.

At the Le Roi plant we also tried mixing Wilfley concentrates, before dewatering, with unsettled flotation concentrate, in the belief that porosity of the latter would be increased, and settlement in bins would be sufficiently satisfactory without compacting, but we did not accomplish a practical success in the operation.

Although the contour of ground on which the plant is to be built determines the arrangement of floors to a large extent, some latitude is afforded. A certain amount of fall is of course inevitable between Blake crusher and Chilean or ball mill, but thereafter, in a "one-man" plant, a flat layout has much to recommend it, inasmuch as a large range of visibility and ready access to all points are thereby gained. For example, putting flotation machine and tables on the same floor necessitates the installation of a sand pump, but the millman has everything accessible, and the arrangement is perhaps better than the two floors. This applies of course only to a "one-man" plant.

The degree of perfection which has been reached in the design of sand pumps makes the elevation of ore pulps about as satisfactory and simple as that of pumping water, and overcomes, in certain measure, former disadvantages of a flat layout.

A sketch is given of a suggested layout for a small plant, of the kind under discussion. This is self-explanatory, save that if choice falls on a ball mill as the grinding machine, working in closed circuit with a classifier, it is well to put an additional small pulley on the ball-mill pinion shaft for the purpose of operating the feeder delivering ore to the ball-mill scoop. A Challenge ore feeder readily lends itself to this arrangement, the shaft of the feeder being placed above and parallel to the ball-mill pinion shaft to which it is belted. With this arrangement, the act of stopping or starting the ball mill automatically stops or starts the ore supply.

In the sketch, concentrate shipping bins for receiving the compacted and dewatered concentrate are shown immediately below the compacting and dewatering bins. It is assumed that concentrate from the latter is shoveled out, dropping through trap doors in the floor to shipping bins below. The shipping arrangements and facilities in connection with any particular plant must govern the most economic arrangement of bins. It might, for the sake of argument, be much more convenient to pipe the concentrates before compacting or dewatering (flow being either by gravity or sand pump) for a considerable distance, and dewater at the shipping point. Local conditions must be known before intelligent planning is possible.

Some Things to Remember

Experience of a quarter of a century in mining and milling inclines me to the belief that in many small operations untoward results have occurred from following too closely the patterns of large plants; that is, attempting too close savings. This is not to mention putting the cart before the horse and erecting a mill before there is any tonnage blocked out in the mine.

High recovery is frequently obtainable only by a refinement in equipment which is not justified by the life of the mine. Given a large tonnage of reserves, sacrifice of metallurgical efficiency to curtail equipment is nine times out of ten unjustified.

Not infrequently the small operator is led to attempt the solution of the problem of making a profit from a *small* tonnage of *low-grade ore*—certainly one of the most dangerous things to attempt, and calling for a high degree of ingenuity and a large amount of practical experience. Quite frequently the feed actually milled proves to be somewhat lower in grade even than the estimate, and only a very slight falling off in recovery is needed to convert an estimated profit into a loss.

The situation conceivably might be retrieved, where feasible, by increasing the capacity of the plant, or improving recovery or adopting both of these expedients. But both will probably involve an expenditure which the life of the property may not justify.

Small operations require just as careful preliminary test work as large operations, and if the ore under treatment is partly amenable to water concentration, it is highly advisable in the preliminary investigation to ascertain exactly what proportion of the total is so amenable. Often the cost of recovery beyond a certain point exceeds the value of the mineral recovered.

With low-grade ore, it is of vital importance that calculations should not be upset because the estimated capacity is not reached through failure of the ball mill to meet expectations in tonnage. It is well to provide a liberal factor of safety by installing a ball mill of a capacity considerably in excess of that estimated to be needed. Errors in overestimating the capacity of the coarse-crushing department are not likely to occur.

The rate at which it is possible to feed material into a ball mill does *not* depend upon the rate at which the scoop can pick up feed, but upon the rate at which the feed can pass through the trunnion. A spiral in the feed trunnion insures feed at a certain rate, but it *prevents* a faster rate of feed; consequently, a smooth throat increasing in diameter toward the mill is far better than a spiral. Troubles in feeding may often be entirely eliminated by the simple expedient of removing the spiral. It is essential to have a renewable liner in the trunnion, and the diameter of the throat should be of liberal dimensions—at least 8 in., even in a small ball mill designed to handle coarse feed.

If the ore under treatment is a copper ore, say chalcopyrite, with a preponderance of pyrite or pyrrhotite, sulphides which *per se* are valueless, it is obvious that the aim must be to recover precious metals with the copper concentrate, and not with the iron concentrate. Indeed, any such recovered in the latter must be regarded as lost, unless in excess of the cost of smelting the iron concentrate. For example, laboratory tests might indicate a 90 per cent gold recovery, 75 per cent of the gold being recovered in the copper concentrate, and 15 per cent, say, in a pyrrhotite concentrate assaying only a few dollars in gold, and less than the smelting cost. The commercial recovery of gold is therefore 75 per cent, not 90 per cent. Such a point may be obvious, but in my experience it is not to the small operator. It is manifest that in this kind of ore, flotation tactics will have as their object the damping of the iron and floating of the copper and gold. This will probably make necessary floating in an alkaline circuit. The desired end may be furthered by coarser crushing, chalcopyrite floating so much more readily than pyrrhotite. On the other hand, it may be that extremely fine grinding is essential to free the gold.

In tabling pyrite or pyrrhotite containing gold, it is probable that the finer grinding will result in higher gold recovery, not necessarily because the sulphide recovery is thereby improved, but merely because the finer grinding liberates the gold from the sulphides.

With mixed lead and zinc ores, where the association of minerals is not intimate, the small operator will probably find it advisable to float the lead and zinc together, separating the floated product on tables, rather than to attempt differential flotation.

Mining on the Top of the Rockies

Surface plant of the Sunnyside Mining and Milling Co. near Silverton, Colo. The ore is transported by an aërial tramway to the mill in a neighboring canyon

The Ghost of the "Molten Magma"

By J. Volney Lewis
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THE "molten magma" is a ghost, a mere shadow, from which modern science has extracted the last atom of substance. Like the dodo it is a relic of an outgrown yesterday which no longer stands for reality. But, unlike the dodo, the molten magma was never more than a phantom, a mistaken fancy. The term no longer serves a useful purpose. On the contrary, it confuses and misleads, and it should be banished from the language of science to the limbo of disembodied spirits.

In order to guard against loose and sloppy thinking, it is occasionally necessary to recall certain fundamental distinctions. We are largely creatures of habit, and it takes an effort to avoid confusion of ideas when words are used without careful discrimination as to meaning and connotation. Fortunately, the ideas behind the words *fusion* and *solution* have become much more clearly differentiated with the progress of physical chemistry in recent years. Thus, when common salt or sugar is stirred in water the solid becomes liquid at a temperature far below its melting point. We say it has been dissolved; but even in such simple cases the distinction is not always made, and we sometimes hear the remark that the sugar in the coffee was not all "melted." Generally, however, in such typical examples, solution is clearly distinguished from the liquefaction of a solid due to fusion, or melting.

A Simple Experiment

The distinction is less obvious and may be wholly lost to the man in the street (or in the stope) when solids enter into mutual solution and simultaneously become liquid. A well-known example is the common freezing mixture of ice and salt. With due regard to season, this simple experiment may easily be made at Butte or Porcupine. When the mercury is solid, grind fragments of ice and salt together in a mortar. The mixture forms a fine dry flour which remains dry indefinitely.

But take it into a closed room and slowly raise the temperature. Now, if the ice and salt had been kept separate nothing remarkable would happen. The ice would simply begin to melt after the temperature had been brought up to zero Centigrade, its fixed melting point, or the freezing point of water; but the salt would require a furnace heat of 800 deg. to melt it. On the other hand, the mixture of these two solids, with a little care as to proportions, will liquefy at minus 22 deg., while the separate ice and salt still remain wholly dry and solid. These solids are not melting below their well-known melting points. The magic touch of one upon the other has brought about mutual solution.

Similar examples are common among the metals. Thus, when gold is placed in mercury at ordinary temperatures the liquid metal dissolves, or amalgamates, the solid one. There is no thought here of melting the gold at a temperature perhaps 1,000 deg. below its melting point. In like manner solid metals may also dissolve one another. The many so-called fusible alloys of tin, bismuth, cadmium, and lead are well-known examples. Heated side by side in separate crucibles, these metals melt one by one, in the order named. Tin is the first to go, always at exactly 231.9 deg. C.; then bismuth at 271 deg.; cadmium at 321; and, finally, lead at 327.3. This is obviously simple fusion. Each metal melts at a temperature that is as definite and characteristic as its specific gravity, its atomic weight, or its chemical properties.

But place the metals in intimate mixture in one crucible, and what is the result? Set a beaker of water alongside the crucible and heat gradually. Before the water boils the metals have all become liquid! One particular combination, known as Wood's metal, becomes liquid at the amazingly low temperature of 60.5 deg. C. A spoon made of such an alloy looks like silver, but it cannot be used in hot tea or coffee. Obviously, we are here dealing with something wholly different from simple melting. The rigidity of each metal vanishes upon the sympathetic touch of its neighbors, and they merge in mutual solution.

Definition of Igneous Magma

An igneous magma is a complex system of metallic and non-metallic substances that may remain in mutual solution at temperatures far below the melting points of the silicate and oxide minerals that eventually crystallize from it. There are also volatile substances, such as water gas and small amounts of sulphur, chlorine, fluorine, and boron—the so-called mineralizers—which aid materially in lowering the solution temperature of the mixture and in maintaining a higher degree of fluidity than would be possible without them. These substances generally escape from the magma during its solidification into rock; hence this rock requires a higher temperature to "melt" it than that at which it solidified; but it will still liquefy at a temperature below the melting points of its chief constituents. In other words, the mineral aggregate forming an igneous rock may pass into mutual solution before sufficient heat has been applied to *melt* any one of the minerals. Both the original magma, however, and the "molten" rock, which lacks most of the original volatiles, are clearly solutions.

Magma Not "Molten"

We inherit not only the progress of the past generation but also its errors. One of the most persistent of these is the idea that igneous rocks have been formed from a state of fusion. The literature of geology and ore deposits is full of expressions that tend to perpetuate this error and its attendant confusion of thought. This hampers the progress of the science, and particularly that branch of it which includes the great majority of ore deposits. The terminology must be revised and brought into harmony with the present state of knowledge. Why go on speaking and writing of "molten magma" and then appending the explanation, like an afterthought, that of course we do not mean "molten" at all, because a magma is a solution? Yet current usage continues to sanction this and similar expressions of wholly erroneous meaning. The clearness and accuracy of our thinking can seldom run far ahead of the language in which it is expressed.

Methods of Gold Mining in Eastern Siberia

Climatic Conditions Influenced Operations Greatly—Many Systems Followed

By A. P. Sviridoff

Formerly General Manager, Verhne-Amursky Gold Mining Co., Eastern Siberia

IN ADDITION to the material given in my previous article[1] I wish to offer some additional data concerning the methods and cost of prospecting and working the mines in the described gold-mining districts of Eastern Siberia.

In Amur and Maritime provinces the following methods of prospecting have been applied in the examination of gold placer mines: (a) by test shafts; (b) by boring machines; (c) by caissons; (d) by prospecting dredges. Up to the present the most widely used of all these methods is prospecting by test shafts.

The main reason for prospecting by test shafts is that it is so universally known, and in spite of primitiveness it reveals most correctly the structure and nature of the gold-bearing placers. Besides this, prospecting by test shafts is nearly always accomplishable and practicable, in the long and cold winters, and in frozen ground of some localities, and is suited to the slight depth of the alluvial placers. The cost of shaft sinking is only a little more than the cost of sinking a 4- or 6-in. bore hole to the same depth.

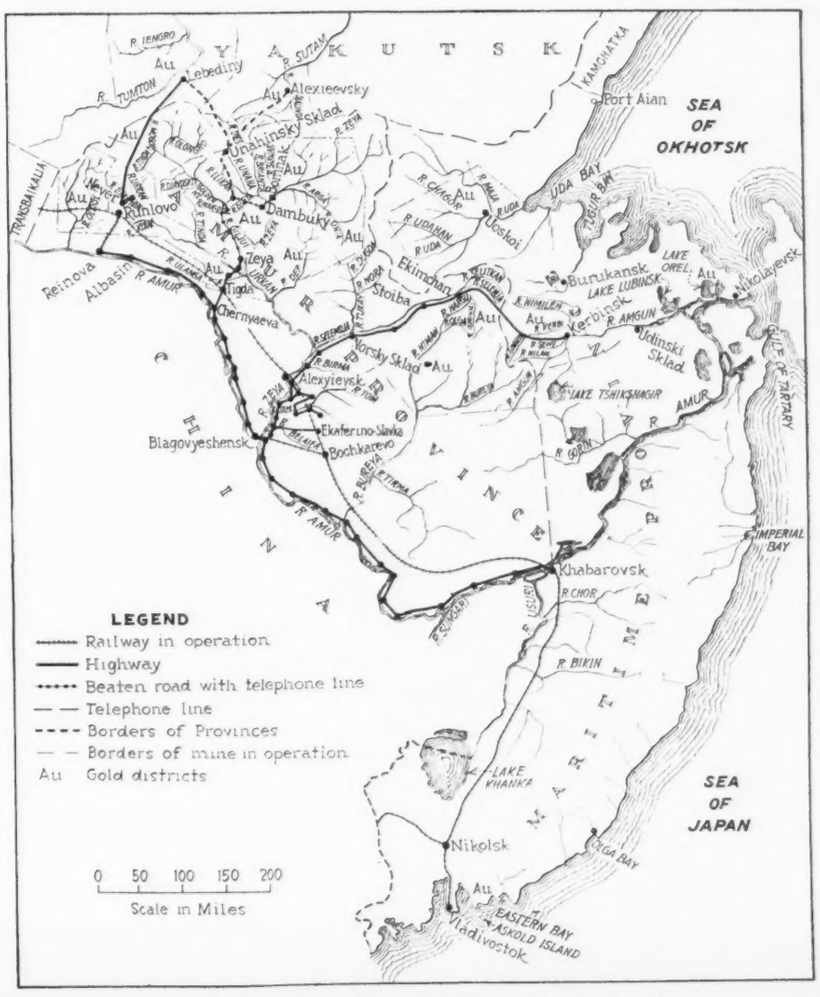
Both in localities with perpetually frozen ground and in places where frozen ground is not encountered, but where there is an influx of water which is not removed, prospecting by test shafts is done in the winter. In both cases the method of wood firing —that is, the slow burning of logs inside the test shaft to thaw the frozen ground—is applied. The difference between these two operations consists only in the fact that in prospecting by test shafts in places where there is no frozen ground the shaft is usually sunk in order to let it "freeze up"—the prospecting shaft is allowed first to freeze up to a certain depth and then wood is thrown in it in such a quantity that after the removal of the thawed layer there will still remain a frozen layer about 5 in. thick; whereas, in prospecting in perpetually frozen ground all the attention is directed upon the intensiveness of the thawing of the gravel.

Usually, the sinking of test shafts in Siberia is begun in the month of November after the formation of a frozen layer on the day surface, but where the water level is lower than the earth's surface the sinking is started earlier and the test shafts are sunk in the naturally thawed ground until they reach the surface of the ground water.

With the beginning of the winter's cold the next shaft sinking is done by means of freezing or by wood firing with all precautions, as they say in Siberia, so as not to injure the shaft—that is, not to break through the separating frozen layer and not to connect the shaft chamber with the ground water. The thickness of the frozen layer in the test shaft is usually ascertained by the workmen by means of tapping on the bottom of the shaft, but this is not reliable.

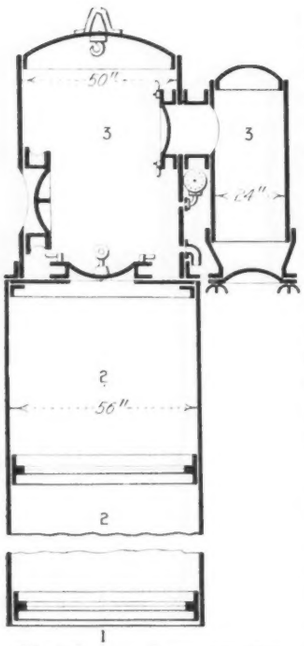
For finding the thickness of the frozen layer, it is useful to apply a hand drill, similar to the ordinary mechanic's chisel, about 1 in. wide and 15 in. long. It is advisable in doubtful cases to pierce a round hole until water appears. Immediately upon the first appearance of the water, the length of the drill which went into the ground is marked, the drill removed, and a wooden stopper, previously prepared, is inserted in its place.

The application of such a method of examination of the thickness of the frozen layer is useful in the Amur, Maritime, and Yakutsk provinces also, in view of the fact that sometimes on one and the same area



Map of Amur and Maritime provinces, Siberia

[1]Published in the *Engineering and Mining Journal-Press*, Oct. 13, 1923, Vol. 116, No. 15.



Sketch 1—Cross-section of the caisson

some of the shafts go through naturally thawed ground, though others encounter the perpetually frozen ground, which spreads along the whole depth of the test shafts and even below them, sometimes at the surface and sometimes at different depths. Such phenomena are frequently observed in Maritime province in the basins of the Kerby and Gongren rivers and in the system of the Amgun River.

When prospecting is carried on with a test shaft in perpetually frozen ground, the average rate of sinking per day per man is usually from 21 to 28 in. and sometimes reaches 35 in., depending partly upon the heat conductivity of the rocks and mainly on the experience of the workmen. On an average, when making a contract to sink test shafts with two men, it is feasible to be guided by the assumption that their daily productiveness will be about 28 in. However, if the prospecting work is done in winter in localities where there is no perpetually frozen ground, the efficiency of sinking is somewhat decreased. In such places the work by wood firing in the naturally thawed ground is influenced mostly by climatic conditions.

Similar conditions are observed very often in the Maritime Province in the region of the Amgun, Kerby, and Uda rivers, due to which the limit of the depth to which the freezing method may be applied is considered to be no more than 23 ft.

In the Amur district the amount of snowfall is less, and therefore in places where perpetually frozen ground is not encountered, the depth limit of test shafts can reach 28 ft. without necessitating the removal of water by artificial means.

The number of logs necessary to thaw the frozen ground depends upon its heat conductivity and also on the ability to utilize wood fires properly. It is possible to calculate on an average that for the thawing of one cubic yard of gravel approximately from one-fifth to one-quarter cubic yard of pine logs are necessary.

In the majority of operations the crosscut of the test shafts is accepted as a rectangle in Eastern Siberia. An area 5x7 ft. is usually allowed for a crosscut in the mouth of the shaft in the Amur and Maritime provinces for test shafts. If the shaft prospecting occurs in perpetually frozen ground, then the cost, as I have previously stated, is lowered to an inconsiderable extent.

Cost of Sinking Test Shafts 5x7 ft. in Section

Sinking Depth in Feet	Cost per Foot in Dollars
From 0 to 12	From $0.30 to $0.35
From 12 to 15	From .45 to .50
From 15 to ground	From .65 to .70

Besides the items noted in the table, the following practice generally prevails:

1. The proprietor of the enterprise supplies the miners with a horse to haul fire wood and other necessities, if the distance to the surrounding wood does not exceed 700 ft.; but if the wood is more than 700 ft. away, then in addition to a horse he also supplies them with a stable boy at wages of 75c. per day.

2. The timbering of the test shaft by local sets, which consist of placing timbers about 9 in. thick, split into blocks, upright along the walls of the shaft and locking them every 5 ft. by a horizontal cross brace, is paid extra, at the rate of 26c. per one foot of sinking; and a horse is provided to haul the timbers.

3. Timbering with ordinary ready-made sets, placed horizontally one upon another, is paid at the rate of 13c. per foot of sinking to a depth of 10 ft., and 18c. per foot of sinking from 10 ft. to 40 ft.

4. The cutting of the sets for timbering from the ready timber is paid at the rate 27c. for 1 ft. of depth.

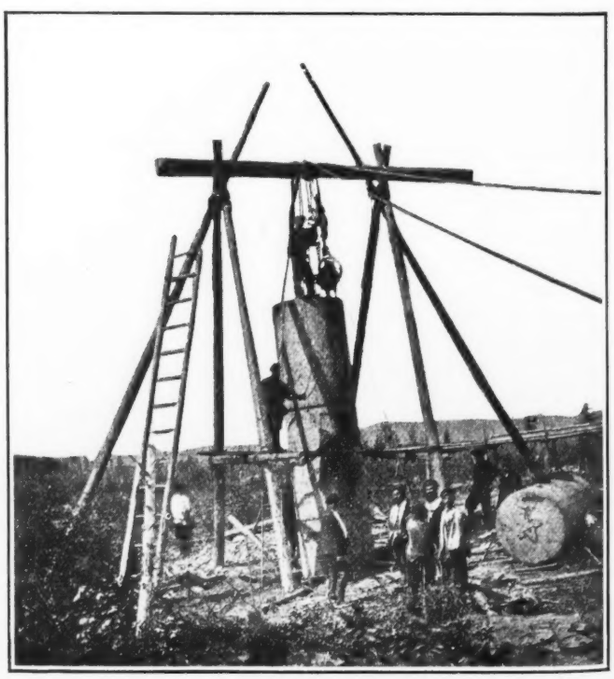
5. The finishing of the shaft to the ground is calculated supplementally: (a) in the edges of the cuts and in the slopes at $1.50 per test shaft; (b) in the river beds and in places with a strong influx of water at from $1.50 to $4 per test shaft, depending upon the difficulty and the degree of importance of obtaining the prospecting data.

6. The washing of the samples is also paid separately. Usually from 0.032 to 0.080 tons—from every 7 in. of sinking—are taken for washing of the samples during prospecting by test shafts.

Taking into consideration the conditions stated above, the average cost of sinking, including all the additional work and overhead expenses—that is, the upkeep of the horse, working men, tools, administrative inspection, washing of sands, and other factors, but not including the timbering of the test shafts—depends directly on the presence of sufficient timber and the difficulty encountered in sinking shafts, and amounts to from $1.55 to $1.90 per foot, or from 1.80 to 2.20 rubles per quarter arsheen (7 in.). If, however, the shaft sinking is not done by contract, but by work paid by the day, then the payment is made in accordance with the following estimate:

Payment to	Per Nine-Hour Working Day in Gold Rubles	in Dollars
Miner	1.70 to 2.00	$0.85 to $1.00
Washer of ore, sampler	1.80 to 2.00	.90 to 1.00
Water pumper	1.50 to 1.70	.75 to .85
Horse	2.00 to 2.50	1.00 to 1.25

The second method of prospecting alluvial gold placers



Prospecting with caisson

in Eastern Siberia is by means of boring machines. The most widely adopted according to the latest reports are the Keystone drill, manufactured by the Keystone Driller Co., and the Empire drill, manufactured by the New York Engineering Co.

In Eastern Siberia, particularly in the Maritime and Amur provinces, the Keytone drill has not as yet found a wide distribution, for the same reasons which I have already mentioned in speaking of prospecting by test shafts—namely, the shallow deposition of the alluvial gold placers in the majority of cases, the cold and long winters, the presence of perpetually frozen ground in some places, and the abundance of cheap labor, which has always existed in Russia and still exists at the present time. Besides this, the utilization of drilling machinery has lagged in Eastern Siberia in general because of the ignorance of boring methods and the superfluous caution due to this ignorance, as well as to the inertness peculiar to the majority of the Russian entrepreneurs.

The cost of sinking bore holes of 6-in. diameter on the placer mines of the Verhne-Amursky Gold Mining Co. in the Zeya Mining District by Keystone Steam Drill No. 4 averaged about 1.40 rubles per quarter arsheen, or $1.20 per foot. In this case as in prospecting by test shafts this cost includes all the expenses incurred in prospecting by drill.

Owing to the light construction of all disjointed parts of the Empire drill, which, in comparison with the Keystone drill, made it more convenient to transport through the Siberian "taiga," and also due to its low cost, interest in this drill increased noticeably, and many of those engaged in gold mining in Eastern Siberia intended to equip their prospecting camps with drills of this type, but the World War and the revolution which followed it in Russia stopped the work.

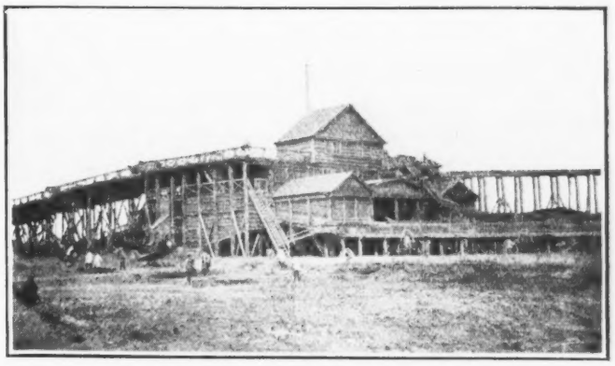
The cost of sinking a bore hole 4 in. in diameter one foot during the boring of alluvial deposits composed of phyllites with a great quantity of granite rock amounted to 60c. in 1914. There were 245 bore holes drilled to an average depth of 21 ft. However, this cost was the lowest. The average cost of sinking one foot during four years of work of the Empire drills amounted to 69c.

Comparison of Result of Prospecting and Recovery

After prospecting by Empire drills the area was worked by dredges, and the resulting relation of the gold won by prospecting to the gold won by dredging is shown below. This covers a period of three years. In this table, 1 dolia equals 0.6857 gr. and one English ton equals 62 poods.

Work of Dredge	Gold Content Won by Empire Drill		Gold Content Won by Dredging	
	Russian Measure	English Measure	Russian Measure	English Measure
No. 1 New Zealand type with 5-ft. bucket capacity, constructed by Werf Konrad, Holland.	5.36 dolias in 100 poods	2.2787 gr. in 1 ton	8.8 dolias in 100 poods	3.7421 gr. in 1 ton
Ratio: Gold won by dredging / Gold won by drilling = 1.64				
No. 2 of the same type and origin but with 7 cu.ft. bucket capacity.	8.61 dolias in 100 poods	3.36607 gr. in 1 ton	10.6 dolias in 100 poods	4.5064 gr. in 1 ton.
Ratio: Gold won by dredging / Gold won by drilling = 1.23				

The last dredge especially shows a ratio close to one. However, I must mention that this ratio is the result of the work of the dredges during a period of three years. In connection with the same ratio it must be noticed that in some parts of the gold-bearing areas it fluctuated greatly, especially where the gold was found in coarser pieces and was of pockety character.



Gold-washing plant of the Urkan placer mine

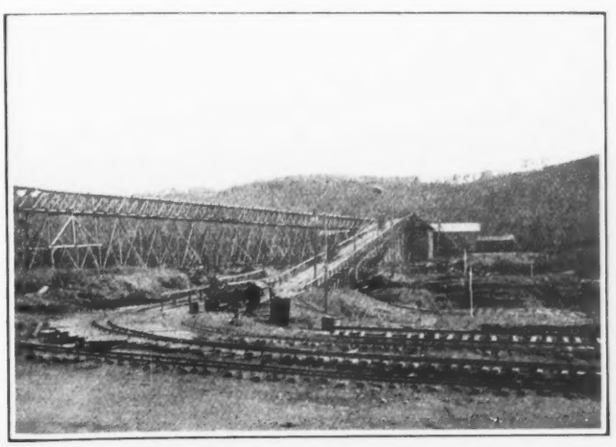
Generally speaking I formed the following conclusions concerning prospecting with Empire drills:

1. The Empire drill established the presence of gold if there was any in the area.
2. At the presence of fine gold of more or less uniform distribution in the placer—that is, when the gold-bearing placer was not of a pockety character—the gold content could be determined closely.
3. In placers with coarse gold and with gold of pockety character prospecting with the Empire drill could not determine the exact gold content and could be used only in preliminary prospecting and not in detailed work.

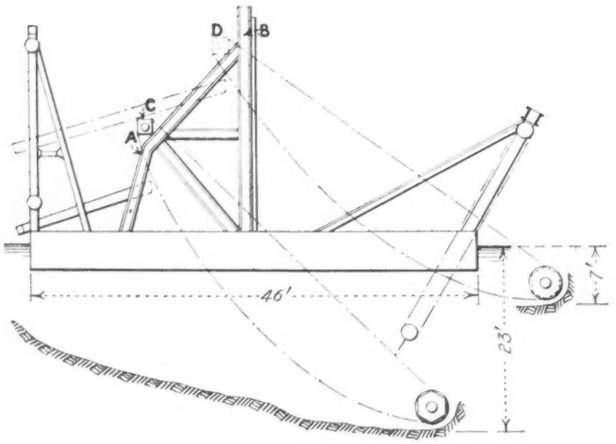
Prospecting Alluvial Gold Placers with Caissons and Dredges

The difficulty of obtaining prospecting data about the gold content in an alluvial gold placer with a great flow of ground water and with a coarse and pockety deposit of gold forced the Amgun Gold Mining Co. to use caissons and a prospecting dredge in the valleys of the Kerby and Gongren rivers (in the Amgun River system of Maritime Mining District).

Prospecting with caissons was applied in a locality with the ground-water level from 5 to 6 ft. below the earth's surface. The caisson consisted of (1) a lower cutting edge or shoe; (2) several intermediary cylindrical sections, the number of which depended upon the depth of the prospecting shaft; and (3) two upper chambers—see Sketch 1. The general scheme of the



Gold-washing plant of the Amgun placer mine



Sketch 2—Werf Konrad prospecting dredge

organization of the prospecting can be seen in an accompanying photograph.

Work was carried on every day in two eight-hour shifts with an average of seven men engaged on each shift. First the sinking was done with a regular test shaft, which was timbered by a local setting. The work was continued until water appeared in the shaft, after which the sinking was done with caissons.

The average cost to the company of sinking in alluvial placer composed of granite rock, crystalline schists, and phyllites amounted to $9.60 per foot, and the sinking of the shaft to a depth of 18 ft. was accomplished in seven or eight days.

In view of the high cost of sinking shafts with caissons in comparison with the described customary prospecting by test shafts and drills, prospecting with caissons was applied only in exceptionally rare cases as an unavoidable and very expensive necessity.

Prospecting with Dredges

The first use of dredges for prospecting alluvial gold-bearing areas in Russia was in 1905. Both the Putiloff Works and the Werf Konrad Co. constructed prospecting dredges of a small type: the Putiloff Works, a steam dredge with 2-cu.ft. buckets; the Werf Konrad Co., a hand-driven dredge with 15 cu.l., or ½-cu.ft., buckets.

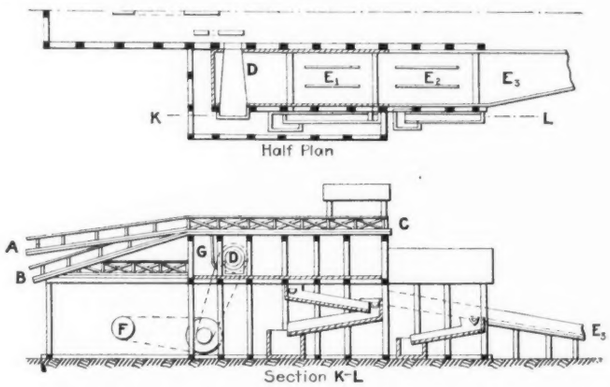
In 1906 the cost of the Putiloff dredge was $15,000 f.o.b. Poushtchino station, Nikolaeff Railway. The cost of the Werf Konrad dredge with a dredging depth of 23 ft. below the water level, without the wooden pontoon, and without the elevator, was $3,650 f.o.b. steamer at Antwerp in 1911, the weight of the purely metallic parts being 15,000 kg.

The dredge put out by the Putiloff Works was not applied for prospecting. The prospecting dredge of the Werk Konrad Co. was constructed in compliance with the order of the Administration of the Amgun Gold Mining Co. and was installed for prospecting of the gold placers in the Amgun River system of Maritime Province.

The wooden pontoon consisted of two separate parts, each part being 14 m. long, 2 m. wide and 1.3 m. high. The two parts of the pontoon were connected by metallic and wooden bracing at a distance of 875 m., thus forming a free space for the movement of the digging ladder and bucket line during its operation, the main gantry being constructed from iron girders 300x100 mm. (See Sketch 2.) Owing to the inclined position of the beam *A-B*, on which were installed the bearings of the axis of the upper drum and of the digging ladder, it was possible, by changing the bearings within the limits from *C* to *D*, to raise or lower the digging ladder and thus to change the digging depth from 7 ft. to 23 ft. from the water level, at the same time maintaining the incline of the digging ladder at 45 to 38 deg.

The digging ladder, 11,900 mm. long, consisted of a continuous construction of heavy plate girders, 260x90 mm. Along the whole length of the frame there were set in twelve pairs of rollers supporting the bucket-line chain. The driving of the bucket-line chain was done by means of a hand winch and tackle. With this equipment the management of the works expected to have ten buckets per minute passing through the upper drum.

The washing and gold-saving equipment consisted of an open sluice with a rectangular cross-section into which the dredged rock was immediately discharged. The dimensions of the sluice, made from sheet iron, follow: Height of the sides at the head of the sluice, 400 mm., at the end 280 mm.; the width along the entire length was constant, 800 mm.; and the length was from 5,000 mm. to 7,500 mm.



Sketch 3—Gold-washing plant of the Urkan placer

Relative to the position of the upper drum, the sluice could be raised or lowered in accordance with the positions of the digging ladder and upper drum, at the same time maintaining the necessary incline to catch the gold (see Sketch 2).

The bucket line consisted of riveted steel buckets, each with a capacity of 15 l. (0.525 cu.ft.), hung on a chain of the bucket and link type characteristic of the New Zealand dredges. The dredge had no conveyor or elevator, and therefore, upon leaving the sluice, the washed rock fell directly into the water near the stern of the dredge. The water supply for washing the rock was delivered by two hand-driven piston pumps. The raising and lowering of the digging ladder and gold-saving sluice necessary to operate the dredge was done by hand winches and tackles.

The dredge described was acquired by the Amgun Gold Mining Co. for the purpose of prospecting the Kerby and Gongren river valleys in the Maritime Mining District and gave the results stated in a succeeding paragraph.

The prospecting dredge of the Werf Konrad type was driven by hand winches. With this equipment, taking everything into consideration, it was possible to raise only a maximum of five or six buckets by dredging, instead of the ten buckets anticipated by

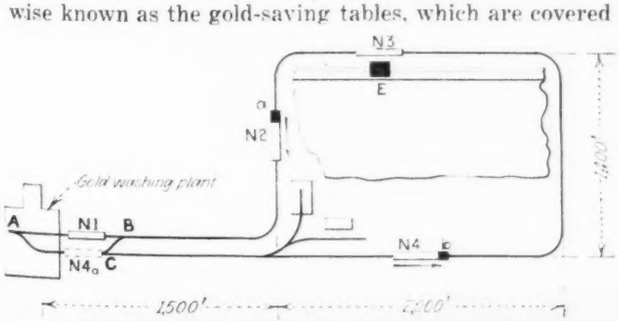
the management. Thus, with a ½-cu.ft. bucket capacity, the productivity during the eight hours of continuous work of the bucket line averaged about 25 cu.yd. per hour.

The daily expense during the work of the prospecting dredge was found to be 44 rubles per cubic sagene, or $1.74 per cu.yd. Thus the small productivity of the dredge gave a high cost of operation, and in addition the following facts appeared: (1) A dredge of small productivity and weak construction could not stand the strain in the bucket line and could not go deep into the firm ground; therefore, if the gold penetrated the ground, it remained undiscovered; (2) owing to the small productivity of the dredge, the excavated space was filled in great quantity by the higher laying gangue, carried by the water flowing in the river, and because of this it was impossible to determine the gold content in the prospected placer.

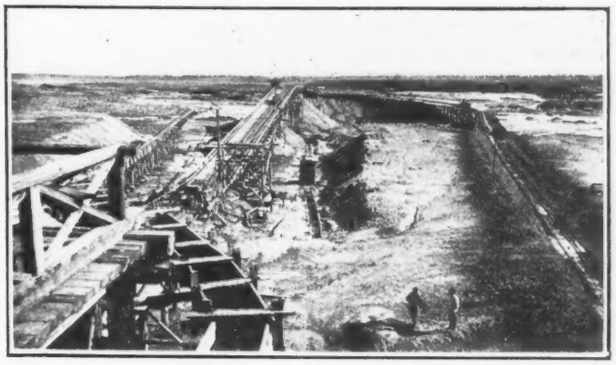
The work of the prospecting dredge of the Amgun Gold Mining Co. was discontinued because it did not produce the results anticipated.

In mining the gold placers of the Maritime and Amur provinces the method of the so-called "zolotnik workings," which has already been described in my previous article, has had the widest distribution during the last twenty years. In the actual carrying on of the "zolotnik workings" the proprietor of the enterprise started the work with the most limited means possible—just the amount necessary for the organization of trade with the workmen in wares, food, and tools, in the majority of cases. Usually, the organizer sold all of these commodities to the workmen in exchange for gold. Then the method of "proprietor's workings" followed. These are carried on at the expense and risk of the owner of the mines and are subdivided into so-called "horse work" and "mechanical work."

In typical "horse work" the winning of gold-bearing gravels as well as the removal of the tailings and pebbles was done by men and horses, but the washing the sands in the majority of operations was done in a one- or two-trommel gold-washing plant. The most widely used type of a two-trommel gold-washing plant is represented in Sketch 3 and the photograph of the gold-washing plant of the Urkan placer mine. The productivity of such a plant is about 90 cu.yd. per hour. In the sketch *A* is the bridge for lifting the sands, *B* is the bridge for lowering the empty two-wheeled carts, *C* is the floor from which the sands are dumped into the gold-washing trommels, *D* is the gold-washing trommel, 15 ft. 4 in. long, weighing three tons (imported from Hamburg). The sifting surface consists of a number of holes ⅜, ½, ⅝ in., and ¾ in. in diameter, beginning at the small inlet (4 ft.) diameter of the trommel and ending at the larger outlet (7 ft.) diameter of the trommel. *E*, E_2, E_3 are the sluices, otherwise known as the gold-saving tables, which are covered



Sketch 4—A gold-washing plant in section



Cableway to remove tailings

by mats or small hair carpets and stencils. *F* is the pulley of the portable steam engine, 18 hp. driving the trommels.

In spite of the fact that the above-given type of gold-washing plant has been in use from the very beginning of the gold-mining industry in Eastern Siberia, the system of water delivery for washing the sands in two trommels has remained extremely unsatisfactory. The water is led toward each trommel along a wooden pipe *G*. From this it is distributed through nine smaller pipes, from one of which it is led into the feed chute. This water washes off the incoming gravels into the inlet end of the trommel. Two other smaller pipes lead the water from the pipe *G* toward the outlet end of the trommel and spray it against the movement of the gravel in the trommel. The remaining six smaller water pipes lead the water onto the outer surface of the revolving trommels, and because of this the water enters the trommels in an extremely insufficient quantity, and the gold-bearing sands, especially the argillaceous ones, are not properly washed. Therefore, many tail dumps have been found to contain an excessive amount of gold and are still being reworked.

The cost of working the sands and turfs by the "horse work" and "proprietor's workings" methods fluctuated within the very wide limits of from 6 to 30 rubles per cubic sagene, or from $0.236 to $1.18 per cu.yd.[2] "The proprietor's mechanical work" was applied as (1) excavator work, (2) dredge work, and (3) hydraulic work. The excavator work was applied first in the Amur and Maritime provinces, where it was in use for a comparatively long time and proved to be applicable for both mining in naturally thawed ground and in areas with perpetually frozen ground.

Mining the gold-bearing sands in the Urkan placers was done with a "ten cubs" excavator, constructed by the Putiloff Works, with the free hanging lower part of the bucket line consisting of riveted steel buckets with cutting edges of manganese steel and with cast-steel handles composing the links of the chain. The general aspect of the excavator is shown in the photograph.

The sands are delivered by two 35-hp. locomotives hauling four train loads on a narrow-gage (600-mm.) railway. (See Sketch 4.) The washing of the sands is done by a two-trommel gold-washing apparatus built according to the type most widely used in the Maritime and Amur provinces and already described in the account of "horse work." (See Sketch 3.) The tailings and pebbles were removed by a cableway.

[2]The average cost of "horse work" fluctuated from 10 to 15 rubles per cubic sagene, or from $0.39 to $0.58 per cu.yd.

Only one "ten cubs" multiple-bucket excavator was used in mining the Urkan placer and this only for mining the gold-bearing layer. The photograph shows the excavator in the second year of work. In view of the insignificant thickness (from 1 to 4 ft.) the uncovering of the turfs was done by hand.

The thickness of the gold-bearing layer in the Urkan placers fluctuated from 4 to 14 ft. The gold-bearing layer consisted of alluvial siliceous rocks of middle coarseness with a considerable content of clay. The coarser pebbles, from 8 to 10 in., were observed comparatively rarely.

The gold-bearing layer rested upon the minutely decomposed granite formation. The excavator received its name of "ten cubs" from the Putiloff Works, where it was constructed, because at the time of its designing and estimating it was assumed that the *hourly* production of the excavator would be 10 cubic sagenes, or 127 cu.yd. The main parts of the excavator made by the Putiloff Works corresponded to the type of "C" excavators constructed by the Lübeck Machine Co. which were in operation by the Amgun Gold Mining Co. from 1901 to 1908.

It became apparent in practical work that, in spite of the favorable conditions of the gold-bearing layer, and the firm ground, consisting of the minutely decomposed granite, the average productivity of the excavator constructed by the Putiloff Works would be considerably lower than was anticipated at the time of designing, and instead of the theoretical productivity of 10 cubic sagenes, a productivity of not more than 8 cubic sagenes was obtained, and the average productivity during the exploitation of the mine in the course of the working year proved to be still lower—namely, 6.3 cubic sagenes or 80 cu.yd. per hour.

The decrease in productivity during the mining of the placer occurred (1) because of the suspension of excavating to permit the locomotives to pass and for the cleaning of the feed opening and the filling of the locomotive tender with water; (2) because of the difficulties and suspension in the movement of the excavator itself, due to the irregular setting of the roadbed on which it moved; and (3) because of the unfavorable positions of the digging ladder with regard to the stope.

It is possible to consider the productivity of "ten cubs" for the excavator constructed by the Putiloff Works as a temporary maximum and possible only in the presence of soft and crumbling rock and the thick layer of the worked stope in the presence of which the digging ladder can remain for a greater time in a position convenient for the loading of the buckets; this productivity is also possible with a firm, good road on which the excavator rolls during the work. However, all this is rarely found in the practical work of placer mining.

One should note by the way that the above-mentioned excavators constructed by the Lübeck Machine Works and applied for mining sands in the placers of the Amgun Gold Mining Co. had shown still lower productivity.

The drag-line excavator constructed by the Putiloff Works was used in mining an area with perpetually frozen ground, located on a slope well drained of the soil water, and therefore having favorable conditions for the movement of the excavator itself during the work and also of the locomotive and cars delivering the sands to the gold-washing plant. The excavator was provided with a transmission of three different speeds (2, 4, and 36 m. per minute) in its progressive movement along the tracks laid along the stope, about 500 m. long.

The first speed, 2 m. per minute, was applied during the summer and autumn when the auriferous layer had thawed to a considerable depth and the frozen ground encountered did not impede the simultaneous lowering of the buckets of the line from 5 to 7 in., which allowed a full load for the buckets at this speed. The second speed, 4 m. per minute, was applied in the beginning of the operations, in the spring, when the frozen ground formed during the winter penetrated to even a greater depth and sometimes came in closest contact with the perpetually frozen ground lying in the lower layers of the soil. With the speed of 4 m. the excavator stripped only the thawed upper layer of from 4 to 5 in. The speed of 4 m. per minute is less convenient than that of 2 m. per minute, because with the former there is more energy spent for the movements of the excavator and more work is required for tramming the cars while loading them, which will be discussed later, but still the 4-m. speed is more useful in the spring than the 2-m. speed, because thawing is going on slowly and the excavator can strip only the thawed upper layer. The third speed, 36 m. per minute, was applied only in spring for returning the excavator to the thawed layer—that is, when the rock thawed slowly, the excavator loading the cars only in one direction. In the reverse direction it did not perform this work, and moved with a speed of 36 m. per minute.

Transportation of Sands Mined by Excavator to Gold-washing Plant

The quantity of rolling stock—locomotives and cars for the timely delivery of the sands mined by the excavator—depends mainly on the distance between the gold-washing plant and the area mined by the excavator and also on the condition of the railway tracks.

In the Urkan placer mines, where the length of each journey was about 9,800 ft., it was necessary for transportation to have three locomotives of 35 hp. each, of which two were always in use and one was kept in reserve, and four trains consisting of from twenty to twenty-two cars each, with a capacity of 1 cu.m. for each car, or a train of sixteen or seventeen cars with a capacity of 1½ cu.m. for each car.

The track for a distance of approximately 4,200 ft. was sufficiently firm and it was possible to use the full speed of the locomotive on it, about 7 miles per hour; but in spite of this, it should be noted that with four trains of eighteen cars of 1 cu.m. capacity, delays in delivery occurred. This indicates that the number of cars given above should be considered a minimum.

In view of the favorable elevation of the track in the transportation of sands in the Urkan placer mines, braked cars were not used. Besides cars already in use, there were ten or twelve spare cars ready to replace cars broken from derailing.

The movement of the trains and locomotives during the transportation of the sands in any moment of the work of the excavator occurred in the following order:

Let it be assumed that No. 1 is a loaded train at the gold-washing plant (see Sketch 4); No. 2 is a loaded train following No. 1 from the excavator to the gold-washing plant, in the tail of which is the locomotive *a*; No. 3 is the empty unloaded train without a locomotive awaiting a load at the excavator (*E*); and lastly No. 4 is an empty train leaving the gold-washing plant, after

having discharged its load, going toward the excavator, at the head of which is the locomotive *b*.

At the time when the cars of train No. 1 are being dumped into the feed chutes leading to the gold-washing trommels and are moved away one after the other onto the siding (*A-C*), passing over the switch *A* to join the train which we call No. 4-*a*, train No. 3 is being loaded by the excavator; and trains No. 2 and No. 4, with locomotives *a* and *b*, are en route, the first traveling from the excavator to the gold-washing plant and the second from the gold-washing plant to the excavator. Upon compliance with these conditions train No. 2 arrives at the gold-washing plant toward the end of the unloading of train No. 1, and train No. 4 arrives at the excavator toward the end of the loading of No. 3.

Upon arrival at the gold-washing plant, locomotive *a* is uncoupled from train No. 2, shunted through switches *B* and *C*, and attached to train No. 4-*a*; and locomotive *b* upon arrival at the excavator is detached from train No. 4 and attached to the loaded train No. 3 by the excavator to haul it to the gold-washing plant, after which the trains and locomotives are again in the relative position which they had at the beginning.

The situation of the Urkan placer mines that I have described had favorable railway conditions, and therefore the grades were considerably lower than the legal limits, which are for the excavator, 0.025; for loaded cars, 0.015; and for empty cars, 0.033 per cent. Besides this, because of the conditions of the locality, the sands were delivered in the cars by the locomotives directly onto the charge floor of the gold-washing plant without the aid of a special cableway hoisting and lowering equipment. These circumstances decreased the expenses for labor, employees, and fuel for the motor, and also reduced the amortization of the equipment for hoisting and lowering.

Furthermore, in the Urkan placer mines the loaded cars moved along the whole length of the excavator way up-grade, and besides this, when the excavator was operated only in one direction (in the spring with frozen ground), the movement of the loaded cars was opposite to the movement of the excavator. Both these circumstances influence the decrease of the cost of the transportation of the sands.

Washing the Sands in the Gold-washing Plant

The washing of the sands won by the excavator was done by a steam gold-washing machine with two conical trommels described in "horse work." Both trommels were driven by an 18-hp. portable steam engine. The haulage of tailings was done with the aid of a cableway which was operated by an 18-hp. portable steam engine, installed separately from the portable steam engine mentioned above.

The necessary rolling stock consisted of iron cars, each of ¾-cu.m. capacity. The first cars were received from the Putiloff Works, but later they were replaced by those made by Arthur Koppel, which were cheaper and more convenient.

As to the rolling stock for the haulage of the tailings, certainly this differs for each separate placer mine with one and the same productivity of the gold-washing plant and excavator, but with different quality of rock to be washed, with different incline of the tailing flume, and different quantity of water used in it. Besides this, the quantity of rolling stock depends also upon the length of the way traveled by each train in one journey. In the Urkan placer mines the cableway for tailings and pebbles used from nine to ten trains of three cars and one platform in each train for the brakeman.

The quantity of water coming into the flume was approximately thirteen times greater than the volume of the washed rock. The incline of the flume was in the ratio 1:86.

The washed rock consisted of (a) 60 per cent clay and sands, which were capable of passing through the ¾-in. holes of the trommel (holes in the intake of the trommel); (b) 15 per cent coarser sand passing through the ¾-in. holes of the trommel (holes in the discharge of the trommel); and (c) 25 per cent of coarser pebbles which could not pass through the holes of the trommel.

Under these circumstances, at the beginning of the mining of the placer in 1908, considering the length of the way over which it was necessary for the train to pass in one trip—about 1,400 ft.—it was sufficient to have nine trains of three cars each. Toward the end of the operations in 1910-1911 the length of the way was extended to 2,800 ft., and it became necessary to increase the rolling stock to ten trains. With the smaller number of trains the flume was congested with tailings and the work of the washing machine was delayed. The arrangement of the haulage of the tailings can be seen in the accompanying photograph.

Expenses of Operation

The average summer expenses for one ten-hour shift, including the mining of the sands, their transportation, their washing, and the haulage of the tailings and pebbles, was 23.5 rubles, or $11.75. During the nine years of the work of the excavator in the Urkan placer mines, 1908-1916, the average productivity of the excavator per hour was found to be 6.3 cubic sagenes or 80 cu.yd., as follows:

Year of Work	Sum of Working Hours	Number of Cubic Sagenes of Sands Mined
1908	2,440	13,929
1909	2,690	15,090
1910	2,620	17,316
1911	2,630	16,668
1912	2,880	17,635
1913	2,620	16,452
1914	2,800	18,708
1915	1,430	10,209
1916	520	3,117
Total for nine years	20,630	129,124

To meet all expenses the presence of the following gold content in turfs and sands together was necessary in the Urkan placer mines with the price of gold 5.00 rubles per zolotnik: 115 dolias in one cubic sagene or 0.013 oz. in 1 cu.yd.

Excavator Work in the Amgun Placer Mines of Maritime Province

The essential difference between the organization of the excavator work in the Amgun placer mines and that of the Urkan placer mines is that instead of only one excavator in use in the Urkan placer mines, in the Amgun placer mines there were four excavators in use from 1901 to 1908, two of which uncovered turfs and the other two delivered the sands to the gold-washing plants. In the accompanying photograph one can see two excavators in action, uncovering turfs and dredging the gold-bearing sands. The gold-washing plants were constructed in accordance with the type of two-trommel plant described above. The essential difference consisted only in that in the Urkan placer mines the sands were immediately delivered to the

Cost of Mining in Urkan Placer Mines and Amgun Placer Mines

Excavator Work	Average Productivity of Excavator per Hour: Uncovering Turf	Average Productivity of Excavator per Hour: Dredging the Sands	Expenses of Mining One Cubic Sagene or One Cubic Yard of Sands: Summer Exploitation Expenses	Overhead Expenses	Total Cost	Uncovering Turfs	Prospecting Work	Amortization of Property	Total Cost	Ratio of Turf to Gold-bearing Layer	Average Cost of Mining Turf and Sands Together
One excavator at work in Urkan placer mines	Turf uncovered by hand and hauled by horses	6.3 cubic sagenes or 80 cu.yd.	3.73 rubles per cubic sagene or $0.146 per cu.yd.	1.70 ruble per cubic sagene, or $0.067 per cu.yd.	5.43 rubles per cubic sagene or $0.213 per cu.yd.	1.08 rubles per cubic sagene or $0.042 per cu.yd.	0.08 rubles per cubic sagene or $0.003 per cu.yd.	1.36 rubles per cubic sagene or $0.054 per cu.yd.	7.95 rubles per cubic sagene or $0.312 per cu.yd.	1:3	5.98 rubles per cubic sagene or $0.234 per cu.yd.
Four excavators at work in Amgun placer mines	8.4 cubic sagenes, or 107 cu.yd.	6 cubic sagenes or 76.2 cu.yd.	6.00 rubles per cubic sagene or $0.24 per cu.yd.	1.82 rubles per cubic sagene or $0.07 per cu.yd.	7.85 rubles per cubic sagene or $0.31 per cu.yd.	8.66 rubles per cubic sagene or $0.034 per cu.yd.	0.31 rubles per cubic sagene or $0.012 per cu.yd.	2.21 rubles per cubic sagene or $0.09 per cu.yd.	19.03 rubles per cubic sagene or $0.752 per cu.yd.	2:1	6.35 rubles per cubic sagene or $0.25 per cu.yd.

charging floor by locomotives and in the Amgun placer mines the cars with the sands were hauled by locomotives as far as the cableway, from which they were each separately lifted by cable. In the photograph of the Amgun gold-washing plant such a lifting equipment can be seen as well as the flume through which the water is delivered to the plant.

The average productivity of the excavators per hour in the Amgun placer mines and also the data about the mining of turfs and sands are given in the above table. It can be seen from this table that despite the difference in local conditions and the ratio of turfs and gold-bearing layers, the average cost of mining of the turfs and sands together differed inconsiderably in both given cases, and when compared with the average cost of "horse work," the cost of excavator work was found to be nearly twice as cheap.

The dredging and hydraulic work in the Amur and Maritime provinces was done on a small scale. With the exception of only one dredge of American construction working in the Orsk company's placer in Maritime Province, all the other dredges were constructed either in Germany or in Holland.

Hydraulic work was done in the Michailovsky placer and in the Verhne-Amursky Co. in Amur Province, and the cost of working one cubic sagene fluctuated from 4.00 rubles to 6.00 rubles, or of working 1 cu.yd. from $0.16 to $0.23, depending directly on the presence of water.

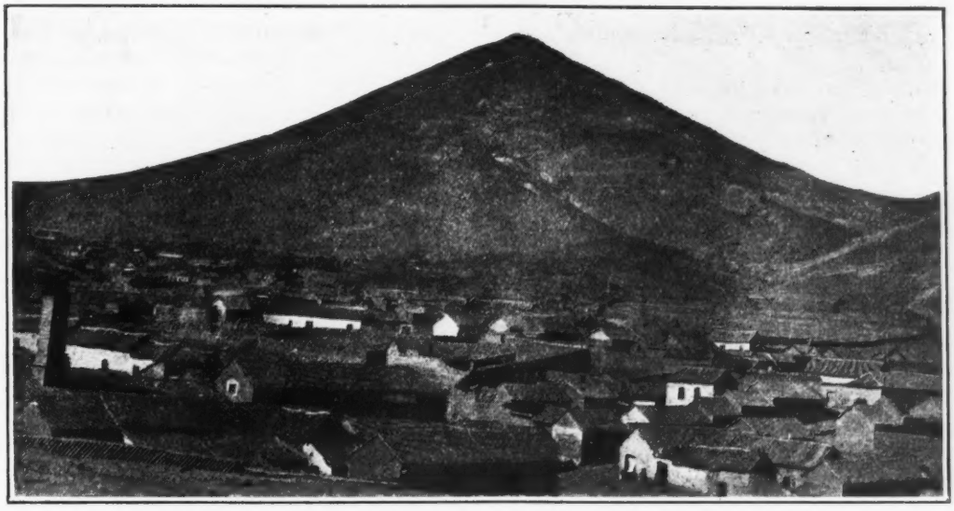
As to the work of the dredges, their location was given in my previous article. The cost of dredging by dredges of the New Zealand type was high, due chiefly to small productivity and weak construction, which were not compatible with the conditions of the work required in the cold climate of Eastern Siberia. Breakages occurred often in autumn, and because of this the period of their yearly activity decreased. I include the following table, taken from the records of the work done in the Amgun placer mines, as characteristic of the work done by dredges with 5- and 7-cu.ft. buckets of the New Zealand type, the most widely used in Maritime and Amur provinces. The table gives the average production per hour, cost of work calculated from the whole time of the work of the dredges, from 1910 to 1914, in the Amgun placer of Maritime Province, and quantity of gold won by them.

Production and Costs of Dredge Work, 1910-1914

Type of Dredge	Production per Hour	Exploitation Expenses	Overhead Expenses and Amortization	Total Expenses	Working Days per Year	Working Hours per Day
New Zealand type constructed by Werf Konrad (Holland), 5 cu.ft. buckets.	3.57 cubic sagenes or 46 cu.yd.	5.45 rubles per cubic sagene or $0.21 per cu.yd.	2.50 rubles per cubic sagene or $0.10 per cu.yd.	7.95 rubles per cubic sagene or $0.31 per cu.yd.	144	17 hr. 6 min.
New Zealand type constructed by Werf Konrad (Holland) 7 cu.ft. buckets	6.45 cubic sagenes or 82 cu.yd.	2.90 rubles per cubic sagene or $0.12 per cu.yd.	2.45 rubles per cubic sagene or $0.09 per cu.yd.	5.35 rubles per cubic sagene or $0.21 per cu.yd.	151	18 hr.

A Modern Silver-Lead Concentrator in the Coeur d'Alenes

The Hercules mill at Wallace, Idaho, which treats the ore from the Hercules mine, at Burke. This is one of the bonanza properties of the West



The famous Cerro Rico de Potosi. Part of the town of Potosi

The Story of Potosi

World's Richest Silver District, Discovered in 1544

By M. G. Edwards
Assistant Professor of Geology, University of California

IN THE LIBRARY of the Bureau of Mines in Lima, Peru, there is a book entitled "Potosi: Historia de sus Minas," by Isidoro Aramayo, which was published by the *Imprenta Municipal, Potosi,* in 1874, just fifty years ago. The work is not unique, as the material published on the subject, especially during Spanish Colonial days, would fill many shelves of a library. The book drew my interest because of a discussion which appeared in the *Mining and Scientific Press* some years ago, reviving various legends regarding the discovery of this most interesting of all silver districts. In addition to the story of its discovery, Aramayo recorded so many other obscure events in Potosi's history that an abstract was made, which is presented here for those who may be interested. In reading such a narrative it must be recalled that the chroniclers from whom Aramayo secured his data were wont to err in the direction of exaggeration and fantasy. However, he wrote with such apparent reserve that he leaves the impression of recording culled truths. All observations for which Aramayo is not responsible are placed in parentheses.

Potosi Means Thunder

From the time of its discovery Cerro Rico de Potosi occupied first place among Spanish possessions in America. Its name dates back to 1462, when a group of Indians, searching for mines in the vicinity of the cerro, were put to flight by a tempest accompanied by violent thunder. The term "Potochsi," a Quichua word signifying noise or thunder, was henceforth applied to the mountain. The title "La Ciudad Imperial de Potosi" was conferred upon the city by Carlos I, King of Spain, in 1553, at a time when rumors of its fabulous riches were attracting adventurers from foreign parts.

The first discovery of silver in the mountain occurred in 1544. An Indian, Diego Guallpa by name, was climbing the mountain in pursuit of an escaped llama. Overtaken by weariness, he rested against a near-by ledge. Pulling a shrub out of the ground, he perceived native silver adhering to its roots. He returned with specimens of the metal, and felt compelled to reveal the secret of its discovery to his master, Don Juan de Willaroll, a miner of Porco, who, according to record, registered his first claim in 1545. (There are many versions of this story extant. The most popular is that the Indian built a fire to protect himself from the chill night and found in the morning smelted silver in the remains of his fire. Inasmuch as some version of the same story is applied to the discovery of many other silver districts throughout the Andes, we may regard it as a plausible legend with perhaps no basis for truth in this instance. Professor Berry points out in a recent issue of *Natural History* that there is not a trace of anything on the mountain which would furnish fuel for a fire. José de Acosta was apparently the first chronicler to give credence to this legend.)

"Rich as Potosi"

From the outset the mines yielded exorbitant riches. The expression "Rico como un Potosi" became a popular proverb throughout the new world. The ore, which consisted of chlorides and the native metal, carried from 25 to 30 per cent silver. It was smelted by a primitive system of crude furnaces called "quairachinas," which had long been used by the Incas. They were so constructed that the wind created a natural

draft. The ore was mixed with lead and carbon and heated, the silver collecting in the lower part of the furnace. Within ten years 6,000 "quairachinas" were in operation.

A tax was imposed on silver in 1556 by the Spanish Government. Records furnish a very imperfect idea of total production, as taxes were not levied with care, nor was there a careful check by either party on the amount of ore extracted, which incited a great amount of smuggling. Moreover, all silver employed in the manufacture of sacred ornaments and household articles was exempt. Nevertheless, records show that an average production valued at 4,000,000 pesos per year was maintained over a period of 246 years. (Acosta placed the value of production between 1545 and 1572 at 250,000,000 pesos.) This sudden influx of wealth exerted a profound influence on the mode of life. It promoted graft and reckless extravagance. At a fiesta in honor of the coronation of Felipe II in 1556, 8,000,000 pesos were expended within a twenty-four-day period for horses, carriages, clothing, and jewelry in Potosi alone.

Amalgamation Introduced in 1572

By 1572 the high-grade surface ore became so nearly exhausted that taxes were reduced and a new viceroy, Don Francisco de Toledo, was sent to Peru in company with Pedro Fernandez de Velasco, a metallurgist, to investigate the mining industry. Under Velasco's direction a new process of treatment by amalgamation was introduced, a process which was still in use in 1874. The ore, after thorough grinding, was mixed with salt and quicksilver and puddled by the treading of mules. This treatment was called the patio process (por patio). Its introduction stimulated the mining industry anew, production increased, and the metal was extracted from greater depths than heretofore. Toledo founded a mint, which was conducted as a private enterprise until 1750, when it became the property of the crown. Under Toledo's regime all of the silver was forced to be sold to the mint at a fixed price, which was often too low to allow a reasonable profit. As a result the industry languished, until the practice was abolished and the operators were permitted to sell the metal to the highest bidder or to export it upon payment of a nominal tax.

Toward the end of the century the industry experienced a further decline, owing to the continued depletion of the easily treated "pacos" ore (native silver and chlorides.) At depth the mines struck ore of a different composition, called "negrillos" (sulphides), which were not amenable to treatment by the patio process. In response to a petition of the "Corporation of Miners" the King reduced the price of quicksilver from the "Royal Mines of Quicksilver of Huancavelica" from 85 to 75 pesos per quintal.

136 Plants in Operation

For many years a storage-reservoir system had been under construction, involving the impounding of the water in thirty-two lakes and distributing it to the mills and to the city. This was completed in 1621 at a cost of 7,500,000 pesos. There were now 136 amalgamation plants in operation, representing an investment of 6,000,000 pesos. However, the civil war which disrupted Spain in 1623 produced disaster even in Potosi, and many mines were temporarily abandoned.

A catastrophe occurred in Potosi in 1626 which had a far-reaching effect upon its future. On the afternoon of March 3 the dam which held back the water of Cari Cari Lake burst, and a torrent of water rushed down the Quebrada Quintumayo, carrying everything before it. At least 2,500 persons perished, including many influential mine owners. Of more than 100 mills situated along the channel, only six were left standing. According to Salcedo, an eye-witness, 8,000 quintals of quicksilver, 200,000 quintals of salt, and 1,500,000 quintals of silver metal were lost. The value of the lost structures was placed at 10,000,000 pesos, not including the loss of silver in plate and jewelry. It was the greatest misfortune which Spain had suffered since the discovery of America. (Aramayo gave the population of Potosi following this disaster as 200,000. Most writers believe this figure excessive, although Calderon, an authority on Bolivia, gave it a population of 160,000, fifty years after the discovery of silver.)

For a few years the mining industry was almost completely paralyzed. Spain, eager for the early resumption of her revenue from the mines, advanced a loan for purposes of reconstruction, but Potosi never fully recovered her former prestige. Labor was lacking and lawsuits were frequent. Difficulties of mining increased with depth, "pacos" ore was scarce, and no system had been devised for the treatment of the "negrillos." This condition prevailed for more than a century. Efforts to revive the industry by rigid slave labor did not relieve the situation. It was given a slight impetus in 1739 when taxes were again reduced from 20 to 10 per cent.

Mining Costs Rose in 1759

In 1759 the Corporation of Miners sent a report to the King which said that "the veins vary from the thickness of a knife blade to a width of several varas, and change in width so abruptly as to confound the miners. The mines are deep and mining is expensive As a consequence of carelessness and lack of efficient system, they are filled with water, caves are frequent, and bad air is prevalent. Surface veins are exhausted. Underground workings form such a complex labyrinth that one who enters loses his way and dies miserably of hunger. Three hundred Indians were buried alive in the Mendieta mine, the surviving miners working for days in a vain attempt to save them. This rich mine is now closed. For all of these reasons mining cannot be continued at depth, an unfortunate circumstance, as ofttimes the richest ore occurs here."

The purpose of this report was to urge the necessity of a drainage tunnel. The "Real Socavon" had been started previously by a miner named Berrios, but had been abandoned. Engineers made surveys and proposed a tunnel in the Santiago Quebrada 230 "varas" below the "Real Socavon." The project, however, fell through. There were now only fifty-five amalgamation plants in operation, producing silver to the amount of 2,500,000 pesos annually, one-fourth as much as was produced 100 years before. Rumors were coming in of a new process, introduced in "Oruro," for the treatment of "negrillos" ores, by which it was claimed that one "cajon" (50 quintals) would yield as much silver as several "cajones" of "pacos" ore. Owing to the difficulties of deep mining it was not yet introduced into Potosi.

In 1778 Governor Escovedo began the "Socavon Purisima" on the east side of the mountain. In twelve years, 1,000 "varas" had been driven. At this time

Baron von Nordenfeldt, a well-known European mining engineer, was sent to Potosi by the King of Spain at the head of a scientific commission. He stopped work on the "Socavon Purisima" and resumed work on the "Real Socavon." He also attempted to introduce a system of amalgamation in use in Saxony which he claimed would yield five times as much silver as the patio process yielded. The system was abandoned, because of the difficulty of securing ore that was suitable to the process.

A report by the governor dated 1794 described the unfortunate condition of the industry. He attributed its failure to lack of faith between miners and operators, the selfish direction of the proprietors, lack of credit, and lack of prompt justice. He furthermore recommended the establishment of a mining school.

The situation remained unchanged for several years. An occasional report to the King urged the completion of the "Real Socavon" in order to develop the "negrillos" ore. The Corporation of Miners reported thirty-five amalgamation plants in operation in 1799. The mines were worked by 7,970 Indians, of whom 5,027 were free workmen and 2,943 were slaves.

Anthony Helms, a mining engineer from Europe, visited Potosi in 1807 and recommended the importation of machinery for unwatering the mines. This move was delayed by the war for independence, which began in 1809 with Potosi as the center of contention. During this period development was at a standstill.

Panic of 1826 Spoiled One Expedition

In 1825, following the declaration of independence, a company was formed in London with a capitalization of £1,000,000 to operate the mines of Peru and Bolivia. Potosi was to be the center of activity. A ship named the "Potosi," carrying a staff of technical experts and all the necessary machinery, tools, and quicksilver, landed in the port of Arica just in time to become engulfed in the financial panic of 1826. The cargo was sold at cost or confiscated by the creditors, and the commission returned to Europe without even having seen its El Dorado.

Two years later a company of forty shareholders was formed in Potosi to resume work on the "Real Socavon." After an expenditure of $75,000 the venture was abandoned. In 1844 another company began the "Socavon Bolivar." This work was stopped in 1850 with a loss of $77,000. Four years later the "Cia. Minera del Real Socavon Potosi" began operations, but abandoned work in 1872 after having spent $391,000.

Why Potosi Declined

Aramayo concluded his history with a description of Potosi in 1874, a decadent Potosi of 20,000 people, with declined commerce and meager production. He attributed the decline to (1) ignorance of mining methods and the short-sighted policy of developing the "pacos" mines only; (2) lack of metallurgical knowledge—no efforts were made to improve the patio process, in which there was a deplorable loss of both silver and quicksilver; (3) lack of capital for ventilation, drainage, and improvements; (4) slave labor was compelled to work in thirty-six-hour shifts; (5) the system of "cajcheo," in vogue since 1750, between proprietors and miners whereby the miners were paid with one-half of the silver extracted. This pernicious practice led to theft and smuggling, it encouraged ruthless exploitation of high-grade orebodies, with subsequent caving of tunnels and loss of stopes; it placed power in the hands of an ignorant class of petty bosses, who sacrificed the future of the mine for selfish and immediate profit.

Since the publication of Aramayo's book, Potosi has seen many changes. Within the last few decades there has been a notable revival of the mining industry, with tin outranking silver in importance. The leading operator on the cerro is Luis Soux, a Frenchman, who owns and operates several mines and a smelter. He uses hydro-electric power and air compressors of American manufacture. The Bebin brothers, also French, own a modern concentrating plant with equipment of American manufacture, using Diesel engines for power. The Anglo-Bolivian Mining Syndicate, Ltd., controlled by the Aramayo-Francke Mines, operates the "Real Socavon." Other important interests are those of Benevides, Cabrimonte, and Medinacelli.

Production of Quicksilver in United States Increased in 1923

The condition of the quicksilver mining industry in 1923 was somewhat better than in 1922, according to Clyde P. Ross, of the U. S. Geological Survey. There was an increase of nearly 14 per cent in the average price at San Francisco and an increase of nearly 25 per cent in the production. The price of the metal declined from $70.70 in the first week of 1923 to $59.35 in the last week, and the average for the year was $65.68.

California produced 69 per cent of the 7,937 flasks of quicksilver credited to the United States in 1923, and most of the remainder was produced in Texas. The increase in the output of the country over that in 1922 was the result of the resumption of production at the New Idria in California. Without this contribution the production in 1923 would have been lower than that of 1922. During 1923 the United States exported 318 flasks of quicksilver and imported 18,073 flasks.

Early in 1924 the price improved notably. If, as seems quite possible, the price can be maintained near or over $70 a flask, there will probably be a further increase in production in 1924, but it is doubtful whether the percentage of increase in 1924 will be so great as in 1923 unless there is an unexpectedly great increase in price.

If the new mercury boiler designed by W. L. R. Emmet should prove as successful in practice as its sponsors believe, it will cause an increased demand for quicksilver, but this demand is not likely to be great in the immediate future. Should it eventually become so, a large part of the quicksilver to satisfy it will have to be sought in foreign countries, for the deposits in the United States do not appear to be adequate to supply it.

Quicksilver Produced in the United States in 1923

State	Mines Producing	Ore Treated, Tons	Quicksilver Obtained — Percentage Tenor Won (a)	Quicksilver Obtained — Flasks of 75 Lb.	Value
California	9	38,648	0.52	(b) 5,447	$357,754
Texas, Nevada, Oregon, and Idaho	5	12,148	0.82	(c) 2,490	163,548
Totals for 1923	14	50,796	0.59	7,937	$521,302
Totals for 1922	10	43,084	0.51	6,375	368,348

(a) Weighted mean for 1923.
(b) Includes 31 flasks obtained from cleanups, and not considered in calculating percentage tenor.
(c) Includes 179 flasks obtained from an unknown quantity of ore and not considered in calculating percentage tenor.

Discussion

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Blast Furnace vs. Reverberatory

THE EDITOR:

Sir—The article in your issue of July 19 on the United Verde smelter was extremely interesting, especially perhaps to those who, like myself, have had to give special consideration to the relative economic merits of blast furnace and reverberatory in copper smelting. Sometimes the physical condition of the charge to be smelted is an important if not the determining factor; for instance, where, as in the case of the United Verde, it can be naturally or conveniently divided into coarse and fine material. But even that is not a hard and fast determinant; for coarse ore can be reduced, and fine material, such as concentrates, can be agglomerated, thus bringing either kind of charge into the special field of the other type of smelting furnace. The extra step in preparation then just becomes an item of cost to be considered in the final comparison. The choice of method, therefore, has a wide range and depends on many local factors and costs. Mr. Young's very informative article about a quite modern plant where both blast furnace and reverberatory are being operated on about the same scale at the same property is a valuable contribution to the industry. And precisely because it is so valuable I venture to ask if it could not be supplemented on a few important points.

Taking it as it stands, the verdict, according to Mr. Young's article, seems to be decidedly in favor of the blast furnace. The outstanding feature of the excellent graphic condensation of facts and figures which he squeezes into his Fig. 2, entitled "Daily graphic balance sheet," is the bold black band which represents "Reverb. slag to waste," consisting of 1,570 tons of slag carrying 12,500 lb. of copper. This represents 5.1 per cent of the total copper charged to the reverberatory. Against this there is the strikingly thinner band of black representing "B. F. slag to waste," amounting to 870 tons with 4,000 lb. of copper, which is only 2.4 per cent of the copper charged to the blast furnace. The saving of copper is thus apparently 2.7 per cent higher by the blast furnace than by the reverberatory; or, to put it into more concrete form, it would seem that the blast furnace loss is 2.37 lb. of copper per ton of charge, while the reverberatory loss is 5.49 lb., a difference in favor of the blast furnace of 3.12 lb. This point will be taken up again later.

On the face of the facts as given one might say offhand that the reverberatories were getting the worst of the deal. Whether one compares the ores, the charges, or the slags, and whether the Al_2O_3 is taken as an acid or as neutral, the ratio of oxygen in acids to that in bases is in each case higher for the reverberatory analysis. Blast furnace conditions are favored by the elimination of fines and by the addition of 10 per cent limestone, which shows up in its slag as 11 per cent, compared with 2 per cent "lime" in the reverberatory slag. Regardless of its being either acid or base, alumina is generally conceded to be a thickener, a retarder, or, as Liddell puts it, "always a nuisance," and the reverberatory has 8 per cent against the blast furnace 7 per cent. Then the reverberatory gets all the flue dust and all of the converter slag. It is the main scavenger, for the converter "chips and cleanings" are just "pie" for the blast furnace. Thus the blast furnace has everything made as favorable as possible, including the recuperation of heat from its waste gases, while the reverberatory is not even allowed in your article to take credit against its $1.30 fuel cost for the waste heat recovered by its boilers. It is true that after very justly pointing out, qualitatively, the benefits from the higher grade matte produced by the reverberatories—and, be it noted, from the lower grade of ore—your article states "The practice of the plant favors the use of more reverberatories." But it would add greatly to the applicable value of this excellent comparison if you could throw more light on the reasons why. For instance, can you give your readers the analyses of the two grades of matte; also a typical analysis of the converter slag, and say where and how it is charged? Inferentially, the bulk is charged in the liquid state; but what about skulls? Has any trouble been experienced from magnetite in and from converter slag? Many metallurgists have found it sufficiently true to use the grade of the matte as a criterion of what the copper in the slag should be. Judged by that criterion, too, these reverberatory slags seem out of line. Do the comparative temperatures help to explain?

After the United Verde's broad-gage public spirit in supplying so much valuable information through the *Journal-Press*, it might seem ill-mannered and too greedy to ask for the real key to the problem. That is, of course, a statement of comparative operating costs, for that, after all, is generally the biggest factor. Without that one can only skirmish around with bits of skeleton keys, like a pick-lock or thief. For instance, using the data given and making some assumptions and guesses based on experience, it can be shown that the cost of fuel and limestone for the blast furnace, on the one hand, and the cost of the fuel in roasters and reverberatories, less waste heat credit, on the other hand, are practically a stand-off. On that basis the metallurgical efficiency assumes dominant importance.

The figures of slag losses quoted from the article would seem to put the reverberatories quite out of the race. Yet the managers of the plant do not think so, and they presumably have good reasons. By a little further study this apparent paradox can be dissolved, for it can be figured out that the notably higher copper loss in slags from the reverberatory is due to its function as scavenger for the whole plant. If the slag loss accruing to the converter slag and flue dust be distributed in proportion to the tonnages of each derived from blast

furnace and reverberatories respectively, it will be seen that in each system the weight of copper lost in the slag per ton of original ore is practically identical. The apparent advantage to the blast furnace disappears.

So far, then, if each of the two systems were standing on its own legs and consuming its own waste or byproducts, the two rivals are really on an equality. But for the blast furnace to comply with that condition there will be more expense for handling slag and more coke per ton of original ore to smelt the cold slag. Against that, the iron brought back by the converter slag would save limestone. But what of the power that is now being supplied by the reverberatory waste heat boilers? Then, the flue dust would have to be briquetted, sintered, or nodulized at additional expense, or else there would be a largely increased tonnage in closed circuit, involving increased handling charges. On the other hand, taking off slag and flue dust from the reverberatory charge would only be a relief to operating costs, because in arriving at the parity of costs above mentioned they were figured on the basis of "per ton of ore," not "per ton of charge."

To meet this suppositious case, moreover, one would have to consider the preparation of the ore for charging. The blast furnace would require briquetting, sintering, or nodulizing that portion of the fine ore which could not be economically charged raw without affecting the present very good coke ratio, and therefore unit costs. Countering that again, the reverberatory system would have to stand the cost of crushing a portion of its ore down to say 1.125 in., as was done to all the ore for both the roasters and reverberatories at the old Highland Boy smelter in Utah.

Taking all these points into consideration, the use of these skeleton keys shows at least that the performance of the reverberatories at the United Verde smelter is not so bad as at first blush it appears to be. Those responsible for the management of that plant have probably a few trumps, even if small ones, not yet on the table, which will doubtless suffice in their case to secure the odd trick for the reverberatories. Nevertheless, the profession, greatly indebted as it is to the United Verde company for the publication of so much about this instructive example, will see from all the side issues briefly touched on in this sketchy review that the problem will have to be closely studied and solved separately according to the special local conditions of each individual case.

Before concluding, I would like to record my great disappointment on finding that the striking illustration on the front cover entitled "A reverberatory interior" was not only not referred to in the United Verde article but was not described nor even alluded to anywhere else in that issue. It is to be hoped that the omission will be made good in the near future, for the "write-up" should prove full of vital interest to copper smelter men and may be spiced with that which journalists are supposed to love—viz., controversial matter eliciting discussion. Like this question of reverberatories versus blast furnaces, that brick-lined bottom may also be found to be a "hot subject." S. SEVERIN SÖRENSEN.

New York, N. Y.

Deep-seated Ore Chemistry

THE EDITOR:

Sir—I have very much enjoyed reading your article on "Ore Injection at Edwards, New York," in the *Engineering and Mining Journal-Press* of April 26, 1924, and I now see that what you intend to convey is not that the whole mass of vein matter was fused and injected as a dike, but as something very different and of an aqueoigneous nature. Still, there is this to consider: the specific gravity of the metallic sulphides is about double that of the other minerals of the vein filling, and according to all known laws of fluids they should go down instead of rise along with the lighter material, unless they were injected at different times or unless they were all dissolved in and precipitated from a common solvent. What solvent could possibly dissolve all the minerals or metals found together in an ordinary mineral vein? The only one that seems to have the slightest chance of fulfilling all the conditions is chlorine. We know from experiment and expensive experience that chlorine will cause the volatilization of all the precious metals and all the baser ones at very moderate temperatures. Also, that it forms volatile compounds with sulphur which decompose at lower temperatures.

The thought which has been forming in my mind for several years in regard to this matter is that all the metals and the sulphur in the mineral veins come up with the magmatic steam in combination with chlorine as volatile material, and as evidenced by the presence of quartz, the waters must have been alkaline, which would mean that they contained an excess of sodium hydroxide. When the temperature was sufficiently lowered along the path of ascent, the chlorine left the metals and the sulphur and combined with the sodium hydroxide and formed salt or brine. The sulphur combined with the metals, and they were then precipitated as sulphides in the place and at the depth where the temperature was right for the exchange to take place. As the chlorides of the various metals would form at and decompose at different temperatures, we would thus have an explanation of the zonal distribution in depth of the various metallic sulphides in mineral deposits. Sublimation as chlorides and subsequent precipitation *in situ* as sulphides would be a plausible explanation of all the sulphide ore deposits, provided there is present in the solutions something with which the liberated chlorine can combine and escape. Silica is soluble in sodium hydroxide, and it is a known fact that all waters which deposit silica from solution are alkaline and must therefore contain that salt or the equivalent in potash or both.

It is therefore a fair assumption that wherever quartz is present in a mineral vein the solutions which deposited it were alkaline and they therefore could combine readily with chlorine as liberated from combination with metals as described. The presence of salt water or brine below petroleum in nearly all oil pools may therefore be explained as a logical consequence of magmatic segregation and ascent of all these products along fractures which are masked by shale beds. The further possibility of metallic sulphides below the brine which may form orebodies of commercial value follows as a logical consequence of this line of reasoning.

If, therefore, deeper drilling in some of the abandoned oil pools of the Appalachian or the Mid-Continent fields should discover sulphides of the metals, we need not be surprised.

Always remembering that a prophet is not without honor, etc. HIRAM W. HIXON.

Switzerland.

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

AMERICAN Silver Producers' Association has been organized at Salt Lake City. The association will not go into export business at this time, though formation of an organization under the Webb-Pomerene Act is declared legal.

Production of zinc in the Joplin-Miami district will be increased soon when the Federal M. & S. Co. resumes capacity output.

Discovery of new orebodies in the Cobalt and South Lorrain districts is reported from Ontario.

C. S. Haley has estimated that 4,000,000,000 cu.yd. of gold gravel is available for mining if the debris problem in California can be solved.

Establishment of an iron and steel industry is the ultimate object of the Argentine Government in asking H. F. Bain to survey the iron resources of the country.

The Tonopah Mining Co. has taken over the Player tract of zinc land in the Joplin-Miami district. This is a new departure for the company.

Operations at the Alaskan mines of the Kennecott Copper Corporation have been temporarily discontinued on account of a fire in the power plant.

Bandits fail to get $30,000 payroll of the Creighton mine of the International Nickel Co.

Bolivian tin mining shares may be listed on the New York Stock Exchange.

Estimates 4,000,000,000 Cu. Yd. of Profitable Placer Gravel

Figures of Californian Engineer — Would Oust Army Officials From Debris Commission

California placers are entirely capable of yielding $5,000,000 per year, in the opinion of C. S. Haley, expressed in a report on the "Gold Placers of California," just published by the California State Mining Bureau. Much weight is given this report in government quarters in Washington because of the knowledge that Mr. Haley has had extensive contact with the placer industry, both in California and in Alaska; he is regarded as an authority on the subject.

There has been a feeling for many years, on the part of some of the government's mining engineers, that the disposition of debris in the placer streams of California is far from an unsolvable problem. Much disappointment is expressed because the California Debris Commission, under the jurisdiction of the Corps of Engineers of the Army, has not made more progress along that line. As a result of Mr. Haley's report, it is believed an effort will be made to transfer that activity to an agency more likely to get results.

The California Debris Commission was created by an act of Congress in 1893 for the purpose of devising methods whereby hydraulic mining could proceed when such operations had been closed by injunction. The study was placed in the hands of Army engineers, because of the reputation that agency had established for impartiality and because the Chief of Engineers is responsible for the maintenance of navigation. During more than thirty years that have elapsed since the passage of the act, very little of a practical character has been done toward making available this important natural resource.

Mr. Haley estimates that some 4,000,000,000 cu.yd. of gravel could be handled at a yield of 15c. per yard.

Germany Buys 4,000,000 Oz. Silver; Requires 20,000,000 More

THE sale of 4,000,000 oz. of American silver to the German Government, for October delivery, has just been announced. Participating in the transaction are the American Smelting & Refining Co., United States Smelting, Refining & Mining Co., the Anaconda Copper Mining Co., and American Metal Co. It is understood that 20,000,000 oz. more will be required to carry out the plans of the German Government for subsidiary coinage. The consummation of the present sale is a direct outcome of the acceptance of the Dawes reparation settlement.

Elkton Reopens Sept. 1

It is reported that the Elkton, on Raven Hill, Cripple Creek, Colo., which has been closed for almost a year, will be reopened Sept. 1. H. H. Barber, of Colorado Springs, will be at the head of the new company.

Change to Larger Air Lines Cuts Quincy Costs

New Pipe 4-in. Diameter—Increases Efficiency—Deep-level Mining Proves Economical

The Quincy Mining Co., in the Michigan copper district, has increased underground efficiency and effected a further saving in costs by replacing the 2-in. air lines formerly in use with 4-in. pipe. The new system provides an ample supply of air for operation of the drills, and as a result more holes are being drilled and more rock is being broken.

The newest openings in Quincy are the richest in the history of the property, according to the miners. The copper is getting heavier with depth in both No. 2 shaft and No. 6 shaft. The vein bears much large and small mass and barrel work, and at times the copper is so heavy that the progress of the drills is impeded. This richness at depth is considered significant of the future of Quincy.

Although No. 2 shaft is bottomed below the 85th level, and No. 6 below the 82d, the system of mining now in use permits successful operations to extreme depths without materially increasing the unit cost. Vertical pillars and horizontal rock-rib fills above and below levels permit a greater extraction of the lode and leave the levels permanently open, with no danger of caving or filling. Eventually, much of the copper remaining in the supporting pillars will be recovered.

Quincy is extensively opened and has large reserves of ground in many levels.

Nice Vacation Trip for Some "Blue-Sky" Commissioner

The Argus Gold Mining Co., an American corporation, has been granted a Dominion charter, and has opened an office in Victoria, B. C. The company, which is composed of Tacoma capitalists, has been exploring a number of lodes on Wilson Island, in Great Slave Lake, Northwest Territory, and claims to have found ore assaying $111 per ton in gold. It has established a camp and done a good deal of surface exploration and some sinking. Recently, a 50-ton mill has been erected. The inaccessibility of the property, which is near the 62 parallel, and is reached by way of the Athabasca River, Athabasca Lake, Slave River, and Great Slave Lake, has greatly retarded the work of development.

Graham Park Basin, at Leadville, Colo., Nearly Unwatered

The unwatering of the Graham Basin properties at Leadville, Colo., by the Leadville Deep Mines Co., of which George O. Argall is manager, and which has been operating for almost a year, will be completed, it is expected, some time next month. The pumps are now throwing 2,000 gal. per minute from a depth of 1,200 ft. The Wolftone mine has been completely drained, and there remains only 135 ft. of water to pump out to reach the bottom of the Greenback mine, when actual mining operations can be started.

California-Rand Silver Netted $113,258 in July

The California-Rand Silver, Inc., milled 9,109 tons of $18.56 ore at its mill at Randsburg, Calif., during July. A dividend of 1c. per share was paid for the month. The declaration of a 2c. dividend was deferred because of threatened shortage of power and a large payment on government income tax which falls due next month.

The extraction in the mill was 76 per cent of the gold, and 93 per cent of the silver, or an average of 90.3 per cent. Net smelter returns for the month aggregated $113,258.

Plan to Stimulate Mining in Southwestern Oregon

The mining district of southwestern Oregon, embracing Coos, Curry, Douglas, Lane, Jackson, and Josephine countries, has suffered from the depression prevailing since the beginning of the war. Eight months ago an effort on the part of local mining men resulted in the organization of the Southwestern Oregon Mining Bureau, one of the main objects of which is the dissemination of reliable information. The bureau is now compiling a register of mines and prospects.

Progress is being made at Mount Reuben, in the Leland district, where Melbourne Bailey is driving a 5,000-ft. tunnel in an endeavor to tap ore at a depth of 2,200 ft. Indications point to a successful outcome of the venture, and five low-grade veins have been found.

American Silver Producers' Association Organized at Salt Lake Meeting

By E. R. Zalinski
Mining Engineer, Salt Lake City

REPRESENTATIVES of American silver producers, meeting in Salt Lake City on Aug. 6, 7, and 8, for the consideration of ways and means to advance the interests of silver mining, effected the formation of a permanent organization known as the American Silver Producers' Association, the purpose of which is "to advise, aid, and support legislation and other procedure looking to the lowering of the cost of production, reduction and transportation, the orderly marketing of the same, the elimination of discrimination against the industry, and to subserve, promote, and protect the interests of all those engaged in the production of silver in the United States and elsewhere, and in that behalf to prosecute any and all lines of activity which may subserve and promote the welfare of the silver-mining industry and . . . those engaged therein."

Features of Salt Lake Silver Producers' Conference

NOTEWORTHY features of the meeting of the Silver Producers' Association were:

1. A favorable report by the Federal Trade Commission on the possibility of forming an association under the Webb-Pomerene Act.
2. Manifestation of a desire by all members present, whether large or small producers, and representatives of leading smelting companies, to co-operate.
3. Decision not to attempt to go into the export business at present, but to have the executive committee of seven members thoroughly canvass the situation and carefully consider vital problems of the enterprise.
4. Determination to back the new organization with every resource of the industry.
5. Preliminary formulation of plans looking to finance and the beginning of educational work to increase the use of silver in industry and the arts.
6. Selection of officers and directors of the association to serve until the first annual meeting in October, 1925.

The decisions of the convention may be regarded as paramount, inasmuch as more than 80 per cent of the production of silver was represented. Every phase of the silver question was carefully discussed, especial emphasis being given to the extension of the uses of silver in the arts and industries, both at home and abroad, to its use for coinage purposes, and to the advisability of the formation of a silver export association. In view of the fact that world conditions point to the probability of the rehabilitation of silver as a medium of exchange, and that a number of foreign countries, notably Germany, Australia, Poland, Esthonia, and Lithuania, are again coining silver (Switzerland in 1923 resumed the coining of five-franc silver pieces), it is natural that the convention should have been much occupied with the question of foreign markets. The recent sale of 6,000,000 ounces of silver to Poland by American producers is an indication of what is possible in providing silver for coinage purposes.

The question of the advisability of the formation of a silver export association was thoroughly discussed by C. F. Kelley, chairman of the fact-finding committee of the convention and president of the Anaconda Copper Mining Co., who devoted eight months' study to the matter. Although the Federal Trade Commission gave a generally favorable report as to the legality of a silver export association, there was left the question of the admission of foreign members; and it was voted by the fact-finding committee, whose report was unanimously adopted by the convention, to defer action on the matter of an export association until the future should give some information respecting its desirability.

In the meantime, it is recommended to study in detail "the practical operation of an export association whose object shall be the orderly marketing and effective distribution of silver, and particularly to ascertain whether existing laws are sufficiently adequate for that purpose, and, if not, then to urge the passage of necessary legislation." The committee further recommends that the Silver Producers' Association "confer with the government or departments of the government, with a view to enlisting some action toward preventing the further demonetization of silver in foreign countries, so far as possible advocating the restoration of silver to its former monetary position." The committee believes this to be of paramount importance in the present disturbed economic condition of the world, and it is therefore moved to its attitude not entirely from selfish considerations, but from the broad humanitarian standpoint that world economics are a factor in the prosperity of this country and other countries.

In regard to the extension of the uses of silver in the arts, the committee recommends the raising of funds by the association "for the purposes of research and advertising, to extend the use of silver in the arts and industries, and in so doing co-operate with the fabricators and users of silver," and the urging of the Bureau of Mines to "initiate research work having for its object the development of new and enlarged uses of silver." The committee suggests that, if adequate government funds are not available, the silver producers be asked to help out, and that they seek further Congressional legislation to make more effective the present law protecting the use of the word "sterling."

The convention was opened on the morning of Aug. 6 at the Hotel Utah by W. Mont Ferry, chairman. The

Officers of the American Silver Producers' Association

THE American Silver Producers' Association, at its recent meeting in Salt Lake City, elected the following officials:

President, W. Mont Ferry, Salt Lake, Utah; first vice-president, F. M. Smith, Spokane, Wash.; second vice-president, Charles Bocking, Butte, Mont.; secretary-treasurer, Henry M. Rives, Reno, Nev.; directors, W. Mont Ferry, Utah; E. J. Raddatz, Utah; F. Y. Robertson, New York, at large; L. O. Evans, Montana; Charles Bocking, Montana; A. M. Morris, Arizona; Alfred Harrell, California; John G. Kirchen, Nevada; Clyde A. Heller, Nevada; F. M. Smith, Washington; Jesse McDonald, Colorado; Jerome J. Day, Idaho; R. E. Tally, Arizona; C. F. Kelley, New York, at large; F. H. Brownell, New York, at large.

The Executive Committee is as follows: W. Mont Ferry, C. F. Kelley, John G. Kirchen, F. H. Brownell. F. M. Smith, R. E. Talley and F. Y. Robertson.

minutes of the Reno meeting were read by Henry M. Rives, secretary of the convention. Copies of the proposed articles of association were distributed among the delegates for consideration and to be voted on later. Telegrams were read from Senator Key Pittman, Charles G. Dawes, and others. At the afternoon session the delegates listened to a speech by Senator Reed Smoot, of Utah, who urged silver producers to organize. Senator Tasker L. Oddie, of Nevada, chairman of the Senate Gold and Silver Commission, outlined the work of the commission in compiling data and in studying the foreign currency situation. He also discussed the question of forming a silver export association under the Webb-Pomerene Act. Among other things of importance in its bearing on the marketing of American silver abroad, he pointed out the efforts of certain foreign governments to stabilize their currencies, in this connection mentioning the purchase of silver for coinage purposes from American sources by the Polish government. He gave an outline of the confused currency situation in China, and suggested that country as a fruitful field for the creation of a market for their product by American silver producers.

Former Senator C. S. Thomas, of Colorado, counsel for the silver producers' fact-finding committee, discussed the Pittman Act and some phases of its administration, urging silver producers to organize for the good of their industry, and scoring the Treasury Department for its failure to purchase 14,589,730 oz. of silver bullion under the Pittman Act, by canceling allocations of silver for subsidiary coinage.

On Thursday morning C. F. Kelley, chairman of the fact-finding committee, gave his report, to which reference has already been made. F. H. Brownell, vice-president of the American Smelting & Refining Co., discussed the difficulties of an export association, and said that if the future showed its need the American Silver Producers' Association could on short notice be changed into an export organization. Mr. Brownell told of the difficulties in making sales to European nations, with losses due in the case of Poland to the rise in the price of silver. Mr. Brownell also detailed the possibilities for expanding the uses of the metal in the arts and sciences. There was a general discussion by J. F. McCarthy, John G. Kirchen, F. M. Smith, R. E. Tally, and others. Final adjournment was taken until the second Monday in October, 1925.

Armed Guards, Protecting Gold Shipment, Arouse Peaceful Community

Value Unknown—Lumber Jacks and Farmers Enticed from Work—No Stock for Sale!

Much excitement has been created at Massett, British Columbia, recently, by the arrival under the protection of an armed guard of the first consignment of gold from the Philadelphia-British Columbia Mining Co.'s new plant, on Massett Inlet. Neither the value of the consignment nor the amount of sand from which it was obtained has been stated, but the arrival has had the effect of stampeding the inhabitants, many of whom dropped their normal occupation of lumbering and farming in order to stake claims along the inlet.

The outlet of the inlet, near which Massett is situated, is on the north shore of Graham Island, which is the northernmost and largest of the Queen Charlotte group. The inlet extends inland as a narrow channel for about 20 miles, when it opens out into a basin, about 20 miles wide and 10 miles long. The shore line is deeply indented on the south, and must have a total length of close to 150 miles. A considerable part of this is composed of black sand that, according to P. Louat, who has done a large amount of testing, in places contains as much as 80c. in gold per cubic yard. The company is not selling stock locally, and the spectacular arrival of the gold at Massett evidently was not a stock-selling scheme—a motive one is likely to impute to many of the actions and statements emanating from embryo mining companies in British Columbia just now.

Armstead Plans Big Merger to Include Utica Mine

H. H. Armstead has returned to Kaslo, B. C., after spending several months in New York. He announces that he has been working on the Canadian Mines Merger, to embrace seventeen properties in British Columbia. A charter was granted on July 2 by the provincial government for a capitalization of $11,200,000.

Titles will be transferred and shares exchanged, and a board of directors will be announced, according to present plans. Among the properties included in the merger will be the Utica mine at Kaslo, formerly a producer of high-grade silver-lead ore; 180,000 first preferred and 500,000 common of the Canadian Mines Merger shares will be traded for 2,000,000 of Utica outstanding at par. The other properties of the merger are not mentioned, but it is understood they comprise prominent mines and prospects at various places in the province. Many mining men believe that this may be the largest promotion that has been effected in the mining industry of the province for many years.

Fire in Elm Orlu Mine Under Control

FIRE was discovered early in the morning of Aug. 3 on the 1,300 level in the Elm Orlu mine, owned by the Clark interests, in Butte, Mont. It is reported that an old timbered drift was burning. No one knows how the fire was started, but it is thought spontaneous combustion was responsible. A crew of 100 men has been engaged in bulk-heading around the fire zone, and the management states that the fire is now under control. A large part of the crew are wearing helmets.

All assistance possible is being given by the Anaconda and Butte & Superior companies. The regular mine forces of the Badger and Black Rock mines were not allowed to go underground until the workings were known to be safe. Both adjoin and are connected with the Elm Orlu. Normal operations in these properties have been resumed.

Lake Superior Iron-ore Shipments Off 30 Per Cent

Iron-ore shipments from the head of the Great Lakes for the month of July totaled 7,280,014 tons, a decrease of 30 per cent in comparison with a like period in 1923, when 10,411,248 tons was handled. In comparison to total shipments of 22,107,142 tons to Aug. 1, 1924, 26,596,731 tons were shipped to Aug. 1, 1923.

The statistics for the individual docks show only a slight decrease in shipments in every instance except the docks of the Duluth & Iron Range R.R. at Two Harbors, and the Duluth, Missabe and Northern R.R. at Superior, which handle the ore of the Oliver Iron Mining Co. on the Mesabi range, where the decrease is approximately 38 per cent. The total shipments at the docks of the Great Northern R.R. at Superior, which handles the ore of the independent mining companies on the Mesabi range, shows a slight gain for the season of 1924.

Remodel Fort Worth Mill

The Fort Worth mill, in the Joplin-Miami zinc district, is being thoroughly modernized by Frank Childress and associates, who recently took it over. New jigs are being installed and new elevators being built. A new shaft has been put down on the eastern part of the lease, and a derrick and hopper is being built there.

Joplin-Miami Zinc Output Due for Big Jump

Federal M. & S. Co. Tires of Curtailment When Others Fail to Co-operate—Kansouri Will Resume

Production in the Joplin-Miami zinc field is scheduled for a decided increase during the coming weeks, owing to the starting up of some of the mines of the Federal Mining & Smelting Co., which have been down for six weeks or more. Among them is the Kansouri, one of the biggest producers.

When the program of voluntary curtailment was entered into about the first of July, the Federal was one of those that indorsed the proposition by practical example. It closed down some of its largest mines, and as it has become one of the largest, if not the largest single producing company in the field, its example, it was hoped, would have a "helpful" effect on the others. But after sticking to the curtailment program for about six weeks, the Federal company evidently has become disappointed with the co-operation offered by other companies, and is leaning once more toward heavy production.

It is notable that the lack of co-operation has come mostly from the smaller companies, which probably will be the heaviest sufferers if surplus production forces down the price of ore.

Teck-Hughes Pays Debts and Has $500,000

The fiscal year of the Teck-Hughes Gold Mines Co., of Kirkland, Ont., will be completed the end of this month. The production for that period establishes a new record in the history of the company. It is expected to run over $1,000,000, and all the outstanding liabilities as shown on the balance sheet at Aug. 31, 1923, have been liquidated. At that time $210,000 worth of bonds were still outstanding, but these have been paid off, and at the end of the present year cash on hand, above all liabilities, will amount to approximately $500,000.

Good progress is being made with the new 1,600-ft. shaft, which is being financed out of current earnings. Ultimately, however, a part of the 495,000 shares of treasury stock will be sold to defray the cost of this work.

Engineer Mines Drives Tunnel in British Columbian Property

Engineer Mines, Ltd., which is developing the Engineer mine, at Atlin Lake, near the boundary between British Columbia and Yukon, has found high-grade ore in four veins, and is sacking it for shipment to Tacoma. Assays are said to vary between $100 and $1,000 in gold per ton. There are twenty-five known lodes on the property, ranging from 1 in. up to 40 ft. in width, but the former owner, the late Captain James Alexander, confined most of his operations to a bonanza shoot of ore, about 4 in. wide and 30 ft. long. He followed this shoot, which is nearly vertical, to a depth of 300 ft., and took out some of the richest gold ore ever found in British Columbia.

In this rugged country near Hope, B. C., is the Eureka-Victoria property, recently reopened

Nuestra Ventura, Cripple Creek Property, Will Be Developed

With the purchase of the McKenzie stock in the Acacia Gold Mining Co. at Cripple Creek, which was recently completed, L. F. LeBrun and his associates now have absolute control of the Acacia company, owning the South Burns shaft, through which the Nuestra Ventura Gold Mining Co. is conducting its operations into the Free Coinage and other claims owned by LeBrun and his associates. Control of the Acacia company is said to be the last obstacle in the way of a campaign of development in the holdings of the Nuestra Ventura company. The purchase price was not divulged, but it is said to have been about 4c. per share for the 200,000-share block.

Another view near the Eureka-Victoria

Try to Exploit Old Eureka-Victoria Properties

J. W. Stewart Opens Tunnels of Mine Near Hope, B. C.—Once Produced Silver Ore

Active development is now under way at the old Eureka-Victoria mines, near Hope, B. C. These lodes were worked fifty-five years ago, and are credited with producing nearly $500,000 in silver ore, which was shipped to England and San Francisco. The mines were apparently forgotten and lost for a number of years. J. W. Stewart and his associates are now reopening the old workings and extending the tunnels to get under the orebodies that are known to exist at the surface.

The face of the old tunnel now being extended shows 3 ft. of ore carrying 35 oz. of silver. The values are in gray copper in a matrix of spathic iron, which at the present horizon is much oxidized. A rhyolite dike cuts the vein, and owing to the erosion of the softer dike rock, a deep gulch has been formed, 200 ft. up the vertical side of which can be traced the Eureka vein, with a width of from 10 to 20 ft. The ore is in a fissured zone in a basal conglomerate tilted to a very steep angle. Limonite, siderite, and quartz constitute the vein material; the mineralization takes the form of freibergite. Old government records give assay returns as high as $1,000 per ton from the Eureka vein, and actual shipments of ore netted the pioneers $420 per ton in San Francisco.

Modern mining and metallurgical methods, together with present-day transportation facilities, should combine to make the reopening of some old mines successful. Field examination of these old operations shows that usually the rich outcrop which was the cause of the discovery has been mined out and its place has been taken by the sloughing of the overhanging formation during the intervening period of fifty to seventy-five years, and usually covered by an exceedingly thick growth of scrubby timber. The prospector, taking advantage of the old geological survey records, may do worse than dig in some of these old localities.

News from Washington

By PAUL WOOTON
Special Correspondent

Sees Increased Demand for Silver in Europe

Economist for Senate Commission Reports Stabilization of Currency —Returning from Abroad, Says Europeans Are Optimistic

CURRENCY conditions in Germany, Austria, Hungary, Poland, and Czechoslovakia are being stabilized with encouraging rapidity, according to Dr. John Parke Young, an economist on the staff of the Senate Commission of Gold and Silver Inquiry, who has just returned from a first-hand study of the situation in most of the countries of Europe. He declares that the people in the countries where the money has been greatly depreciated are thoroughly sick of this type of instability and are demanding "hard" money.

Confidence in paper money is so undermined, Dr. Young says, that unusual quantities of metallic currency will be required because the tendency is to hoard a very considerable portion of such issues. The recent issue of a silver shilling in Austria was absorbed almost immediately and, despite the fact that its purchasing power is much greater than that of its silver content, it practically has been withdrawn from circulation by the public.

Sweden, which recently returned to the gold standard, is determined to stay on that basis regardless of the effort that may be required. Germany and Poland already are coining silver extensively and there is a very general desire throughout Europe to return to the gold basis. When Great Britain takes that step many believe Holland and Switzerland at least will follow promptly, if they do not take that action simultaneously with the British.

Dr. Young expects the silver requirements of Europe gradually to reach considerable proportions. As considerable stocks of silver are available for recoinage, there is some uncertainty as to the amount of new silver that will be required, but the quantity is certain to be large.

Dr. Young expects the pound to make more definite progress toward par in the near future. The deterring influence in Great Britain is the fear that the accompanying deflation will result in further unemployment. The expectation has been that there would be sufficient inflation in the United States to make deflation in the British Isles unnecessary.

Most of the gold now being transferred to the United States, in Dr. Young's opinion, is the newly mined product and does not represent shipments of the European reserves. He finds the people in the various countries he visited imbued with the very hopeful feeling that the marked improvement of the last year is to continue at a greatly increased rate from this time onward.

May Sell Bolivian Tin Shares on New York Market

GENERAL CONDITIONS in the mining industry of Bolivia are prosperous, according to a report to the U. S. Department of Commerce by Consul D. C. McDonough, at La Paz. Since the recent consolidation of the Llallagua-Uncia properties, the two largest tin producers of the country, it has been rumored that the Bolivian capitalist who controls them will form a holding company and place the shares on the New York Stock Exchange. It is further reported that the same interests have secured control of other important tin properties. Production has begun at the principal American tin mines with a monthly output of 350 tons of concentrates. Many Bolivian tin-mining companies are being promoted in Chile. Exports of tin in June amounted to 4,386 metric tons, of which by far the greater part went to Great Britain.

Questions Authority of Interstate Commerce Commission in Intrastate Matter

Questioning the legality of the Federal Railroad Administration Act and the powers of the Interstate Commerce Commission to regulate portions of roads or branch lines entirely within the state, Attorney General Williams of Colorado has filed a bill of complaint in the United States District Court asking for an injunction against the Interstate Commerce Commission and the Colorado and Southern Railroad to prevent the discontinuance of a branch line extending from Buena Vista to Hancock, Colo.

Application to abandon the line, which serves a metal-mining district where operations have been practically inactive for many years, was made in 1921. The application was resisted by mine owners, who claimed that if the road ceased to operate their properties would become valueless, and that with a restoration of normal conditions several of the old mines could be profitably operated.

Upon the showing made by the mine owners, permission to discontinue operation of the road was refused by the Interstate Commerce Commission, with the proviso that if within a certain time conditions did not improve, the road could make a second application. A second application was made in 1923, and early in 1924 the commission authorized the abandonment of the branch road.

Colorado, in fighting the decision, maintains in its action that the Federal Commission has no jurisdiction over such matters when the line in question lies entirely within the state and does not interfere with intrastate commerce. The state claims that this is matter solely for state authorities to settle. The case is filed as a test case and may have far-reaching effects not only on the district served but on other territory where old mines exist.

Argentine Government Wants H. F. Bain to Survey Iron Resources

Would Borrow Mines Bureau Director —Argentina Sees Steel Industry as Link in National Defense

Advices from Buenos Aires are to the effect that the Argentine Government has asked leave to borrow the services of H. Foster Bain, the director of the U. S. Bureau of Mines, to make a preliminary study of the possibilities of developing an iron and steel industry in Argentina. When advised of the reports emanating from the Argentine Republic, Mr. Bain stated that the negotiations had not been consummated and for that reason he would discuss the matter only reluctantly. He admitted, however, that the matter had been discussed, but said that final arrangements had not been perfected.

Approximately four months will be required for the studies the Argentine Government would like to have Mr. Bain make. If the contract is signed, Mr. Bain will be given a leave of absence by the United States Government for that purpose. The study would be along the same general lines as those made some years ago in China. While Mr. Bain would give his personal attention largely to studies as to the availability of the raw materials, and to certain economic phases of the question, he would be in charge of the staff which will make other investigations.

It is understood that the Argentine Government feels that Argentina must enter upon the manufacture of iron and steel as a necessary step in the national defense.

Balbach and Nichols Copper Interests Acquire Linndale Reduction

The election of Archibald R. Watson, James W. Paterson and James M. MacNee, in addition to Julian B. Beaty, Elmer H. Simonson, Walter C. Bennett, hold-overs, to the directorship of the Linndale Reduction Co. confirms rumors recently current that the stock in the Linndale Reduction Co., held by the Koblitz-Kohn Co. of Cleveland, was to be acquired by interests affiliated with the Balbach Smelting & Refining Co. of Newark, N. J.

Mr. Watson, who was elected chairman of the board of Linndale, is also president of Balbach Smelting & Refining Co., and Mr. Beaty, president of Linndale, is vice-president of Nichols Copper Co. Of the other four members of the board, two are also identified with Nichols Copper Co. and two are officers of or have been connected with the Balbach company.

Dynamite Car, but Fail to Get International Nickel Payroll

BANDITS failed in an attempt to get $30,000, representing the payroll of employees of the Creighton mine, of the International Nickel Co., on Aug. 8. Dynamite covered with sand was placed in the wheel ruts and fired as the automobile carrying the payroll passed. The car was wrecked, but none of the four occupants was seriously hurt and the bandits were lucky to escape without the prospective loot.

New Discoveries in Cobalt and South Lorrain Mines

Long Shoot in Lorrain Trout Lake—High Grade From Canadian Lorrain—Keeley Starts Winze

The Mining Corporation of Canada has issued a progress report for the three months ended June 30, which shows that production is being maintained at Cobalt.

Some new discoveries have been made in the old mines, which have provided further sources of ore. In the South Lorrain properties owned by the company a total of 3,487 ft. of development work was done during the period, but this has not resulted in discoveries of particular importance. Exploration at the Little Keeley property will be started from the Frontier workings, but the Forneiri and claims lying to the north of it will be prospected by a new shaft, which will have to be sunk approximately 600 ft. to reach the diabase contact.

On the Lorrain Trout Lake a level has been run 160 ft. at 100 ft. depth and for a length of 167 ft. on a sublevel at 75 ft. Both of these levels show practically continuous shoots of high-grade ore varying from 3 in. to 6 in. in width. Shipments of high-grade ore have been made to the smelter, but returns have not yet been received, and no estimate is given regarding production. It is understood, however, that this production is more than sufficient to pay the total cost of the work to date. In addition to the high grade, a considerable tonnage of good milling ore has been found which will be shipped to the Cobalt mill when the railroad is completed in October.

Recent discoveries on the Canadian Lorrain property, which is controlled by the Keeley interests, have greatly added to its possibilities. Up to within a few days underground operations had resulted in a discovery of considerable milling ore, but no high-grade ore has been found. Recently, however, on the No. 5 vein, at the 250 level, high-grade ore has been encountered which shows an average of about 3 in. of ore averaging 2,500 oz. in silver.

The Keeley has started a winze on No. 26 vein below the eighth level, which will be sunk about 75 ft. The winze has not been started on the rich ore, so that no news of importance may be expected from this until it is finished. The eighth level is the deepest working in the Keeley mine and has provided some spectacular ore.

Amalgamated Gold Mining Co. of Washington To Resume

The Amalgamated Gold Mining Co. will soon resume operations in the Blewett district in Washington. The mine has been idle for about two years. New plans call for turning over the property to a bonding and leasing company.

The mine has produced about $1,500,000 in gold, and the underground workings comprise nearly five miles.

Seventeen-Year Bath Fails to Injure Mine Pumps

Baisley-Elkhorn Mine, Near Baker, Ore., Unwatered—Examination May Result in Resumption

Pumps submerged seventeen years in the Baisley-Elkhorn mine, near Baker, Ore., were found in operating condition when the property was recently unwatered, according to Milnor Roberts, of the University of Washington. Water had stood in the four levels below the main adit since 1907.

Baisley-Elkhorn mine, in Oregon
Recently unwatered after seventeen years, pumps were found to be in operating condition

When the mine was closed down, the pumps were well greased and left in good order. John J. O'Keefe, manager and superintendent, was in charge of the unwatering operations. The four lower levels of the mine are nearly 1,500 ft. in length, and much of the ground between the levels had been stoped to an average width of 5 ft. Unwatering was effected by means of a motor-driven turbine pump. When the water level reached a depth of 150 ft., air pressure was put on the pipe leading to the pump station on the third level at a depth of 250 ft. Under a pressure of 95 lb. the pump responded at once and discharged through the 5-in. water column. While the pump was under water it operated for about thirty hours and after it had unwatered itself, it was continued in service for another twenty hours. Since then the mine has been completely unwatered to the 400 level.

The water packing of the pump was in good condition, but the steam packing was soft and weak. The gaskets held, but were spongy. The pump is a duplex steam pump, altered to permit of the use of compressed air. It was made by the Stilwell-Bierce & Smith-Vaile Co. of Dayton, Ohio. Its size is 12 by 8 by 12 in.

The mine ore consists principally of quartz with a considerable amount of associated fresh pyrite, both fine and coarse. Copper occurs in small amount and carbonates appear as a stain on the dry levels. The mine water is not noticeably acid.

Atlin Silver Lead Ships

Atlin Silver Lead Mines, Ltd., operating in British Columbia, has shipped 30 tons of high-grade ore to the Trail smelter. The company's property is situated up Fourth of July Creek, which runs down into Atlin Lake, and contains a number of parallel lodes, only a few of which, so far, have been explored. The ground is broken, and near the surface the veins are much disturbed. They are, as a rule, well mineralized with galena, chalcopyrite, blende, and pyrite, and their products of oxidation. Last year the company shipped to the Tacoma smelter 12 tons of ore that gave a return of 1 oz. gold, 1,008 oz. silver, 10,782 lb. lead, and 188 lb. copper.

Eagle-Picher Will Sink on Pierce City Property

The Eagle-Picher Lead Co. has shipped a small compressor and gasoline engine to Pierce City, Mo., for use in sinking a shaft on a lease taken over some months ago from George Moore, of Joplin, and Guy Waring, of Oronogo.

The company has been carrying on drilling operations on the lease for about three months and is understood to have located a "sheet-ground" formation at the shallow depth of only about 30 ft. Though the deposit appears to be only about 6 ft. thick, it is high-grade and is expected to give a recovery of about 6 per cent. Interest was attracted to the property by a miner formerly employed by Waring at Oronogo.

London Letter

By W. A. Doman
Special Correspondent

Zambesia Exploring Co. Pays Dividend of 1s.

Sponsor for Union Minière and Tanganyika Companies—Confirms Favorable Reports

London, July 29—With the position and prospects of that great Central African copper producer, the Union Minière du Haut Katanga, I have already dealt. The report of the Tanganyika Concessions, the holding company, has since made its appearance, and this confirms the wonderful progress made. Moreover, the Zambesia Exploring Co., which is the sponsor of both of the above-mentioned concerns, is able to declare what is to all intents and purposes an initial dividend of 1s. per share. This amount does not come out of the profits for 1923, but as at the close of that year further profits had been made, and in view of the conservative manner in which the company is managed, it seems obvious that the directors now anticipate a continuance of profitable operations. In 1896 the Zambesia Exploring Co. paid a dividend of 100 per cent, partly in cash and partly in scrip, but the capital was then much smaller and the distribution was solely in connection with the sale of certain properties to the United Rhodesia Gold Fields and had no connection with copper production, which is the real business of the undertaking, through its subsidiaries.

Lively scenes were witnessed at the recent meeting of the Eileen Alannah Mining Co. (Rhodesia), when a strenuous endeavor was made to wrest the control of the undertaking from the Willoughby's Consolidated. Some months ago it was evident from the nature of the buying that something more than ordinary was in progress. The chairman, Colonel A. Weston Jarvis, put up a good fight, and, as the result of a poll, declared the directors' proposals carried. This decision will probably be challenged. The Eileen property adjoins that of the Cam & Motor, which has proved so successful since Sir Abe Bailey put up the money for further investigation a few years ago. When the recent buying of Eileen was in progress, it was suggested that some of the lodes in the Cam & Motor property were traceable into the Eileen, but little official information was available. Now, Sir Abe Bailey has returned from a long visit to South Africa, and, as he is known to control the Cam & Motor, the inference is that as a result of his personal investigations he deems it advisable to acquire the Eileen. Color is lent to this idea by the fact that a prominent geologist recently appointed by the Cam & Motor directors to examine their property has been asked to extend his examination to the Eileen.

Rochfort Maguire had an interesting story to tell at the first meeting of the British South Africa Co. under the new conditions. The financial position is sounder than had been thought in some quarters, what might be called the working capital being £3,682,600, or about 50 per cent of the total capital.

There is nothing in the June quarterly report of the East Rand Proprietary to account for the recent wild gambling in the shares. Fifty per cent of the development footage sampled was payable, but the Hercules shaft is flooded. It is reported that 117 claims have been acquired from the Knights and Knight Central. The former company's ground is nearly worked out and the latter is in liquidation. Moreover this area is very low grade.

Tonopah Mining Co. Enters Joplin-Miami Zinc Field

THE Tonopah Mining Co., a well-known company operating in Nevada, has taken over the Player 40-acre tract, in the Joplin-Miami zinc-lead district east of the Underwriters' No. 2 and north of the St. Louis S. & R. Co.'s No. 2 plant. A new shaft is being put down by the new owners on the southwestern portion of the lease, where drilling has indicated an orebody. This is the first venture of the Tonopah Mining Co. into operations other than silver and gold.

Fire in Power House Shuts Down Kennecott

A FIRE on Aug. 3 disabled the power plant of the Kennecott Copper Corporation in Alaska, thereby shutting down temporarily the Bonanza, Jumbo, and Mother Lode mines. The loss is estimated at $150,000 and the period before production can be resumed at full capacity will be from forty to sixty days.

Jib Consolidated Defendant in $21,250 Lawsuit

Recovery of 25,000 shares of Jib Consolidated stock, or its equivalent of $21,250, is asked in a complaint filed in district court in Montana by M. L. Hewett against the Jib Consolidated Mining Co., Robert W. Shingle, president, and others.

Hewett asserts that he was a stockholder of the company, owning 15,000 shares, valued at $1.10 a share, and that he transferred it to O. F. Brinton, manager of the Jib company, under the agreement that the latter would pay to him the reasonable market value of the shares, or else transfer to him all of his interest in shares of capital stock of the company that Brinton would receive in return for his services.

It is alleged that Mr. Brinton received 25,000 shares, which were held in trust by the defendant, Horace J. Brown, as agent of Mr. Shingle. The complaint recites that the plaintiff repeatedly asked for the stock, but was refused, and states that the plaintiff believes that he never will obtain possession of the shares unless through compulsion of a court order.

Johannesburg Letter

By John Watson
Special Correspondent

Rand Gold Mines Spent £26,553,094 During 1923

Output 8,898,731 Oz.—54 Per Cent of World's Production—New Diamond Diggings Proclaimed

Johannesburg, July 7—Last year, the Witwatersrand mines produced 8,898,731 oz. of fine gold, having a value of £39,061,604. This was approximately 54 per cent of the world's output and 72½ per cent of the output of the British Empire. The working expenditure absorbed £26,553,094.

E. Miles Sharp, manager of the New Modder gold mine, left on June 26 on a six months' visit to England. During his absence, E. C. J. Meyer, of the E. R. P. M., will act at New Modder. A. H. Krynauw, assistant manager, will be in charge of the E. R. P. M. Mr. Sharp, when leaving the Johannesburg station, was bidden godspeed by a considerable number of friends, including Sir Evelyn Wallers, Sir Julius Jeppe, and several well-known Johannesburg mining people.

On June 30 General Hertzog, the new Premier, announced the members of his cabinet to the Governor-General, and the new ministers were sworn in. The new Minister for Mines and Industries is F. D. Beyers.

During the last week, there has been a rise of Transvaal Platinum shares on the Stock Exchange, these having gone up to 85s. per 5s. share for odd lots July 3, whereas there was a sale at 63s. 6d. a week before. On July 2 there was a sale of 200 of these shares at 81s.

The government returns of alluvial diamonds for the Transvaal Province show a total value of £99,312 for the month of May. The value for April was £868 higher and for March more than £9,000 higher still. In May 2,751 diggers were working, out of which number 1,842 registered finds. One digger working on the farm Zeekoefontein, in the Patchefstroom district, registered 503 carats, having a value of £4,125.

The diamond diggings at Zeekoefontein, on the Vaal River, near Lindegue's Drift, will be publicly proclaimed on July 11; one portion at 11 a.m. and another portion at 3 p.m. Licenses will be issued on the spot, on the day of the rush and for two preceding days. The usual race for what are considered to be the choice locations will probably follow.

Mill Planned for Goudreau

Plans for a 100-ton mill for the Goudreau gold mine, at Goudreau, in the Algoma district of northern Ontario, have been completed and construction will be undertaken at once. The property shows similar general geological conditions to the other north Ontario gold fields. Two shafts, 500 ft. apart, have been sunk to the 450 and 200 levels, and at the 450 level the vein, which appears to have a width of about 24 ft., has been opened up for 500 ft.

Men You Should Know About

Morton Webber was recently in Italy and is now in London.

F. E. Calkins is examining mining property near Arizpe, in northern Sonora, Mexico.

Angel St. John has resigned from the staff of the Union Carbide and Carbon Research Laboratories.

Guy Byorge, geologist of San Francisco, is engaged in professional work in the Globe district of Arizona.

D. D. Irwin, general superintendent of the Copper Queen branch of the Phelps Dodge Corporation, was a recent visitor to Hayden, Ariz.

G. H. Dowell, manager of the Copper Queen Branch of the Phelps Dodge Corporation, has returned to Bisbee from a trip to California.

T. H. O'Brien, general manager of the Inspiration Consolidated Copper Co., has returned to Miami, Ariz., from a business trip to New York.

Alex H. Smith has been appointed manager for the British Canadian Mines, Ltd., at the Foley mine, Mine Centre, Ontario.

Paul N. Boggs has been made general manager for the Union Oil Co. in California; he is also chairman of the board of the Union Tool Co.

Theodore B. Counselman, until recently metallurgist for the Mesabi Iron Co., has become western representative for the Clark Car Co. at Chicago.

E. G. Dean, general manager of the Superior & Boston Copper Co. in the Globe district of Arizona, has just returned from a trip to Toronto, Canada.

James L. Bruce has returned to his headquarters in Salt Lake City, after a month spent in professional work near Knoxville, Tenn., and in southeast Missouri.

George H. Horne, field engineer for the Western Precipitation Co., who recently completed an engagement at the Aramayo de Mines en Bolivie, has gone to New Castle, Pa.

H. M. Kingsbury, of the office of Augustus Locke, geologist of San Francisco, is making an extended geological survey of the Copper Queen mine, in Bisbee.

R. H. Stewart, of Vancouver, has been in New York in connection with the financing of the Ruth-Hope Mining Co., in which, it is understood, he has been successful.

S. F. Shaw, who recently resigned from his position with the Compañia Minera de Peñoles at Sierra Mojada, Mexico, will make his headquarters in San Antonio, Tex.

T. E. Swigart, superintendent of the Bartlesville Experiment Station of the U. S. Bureau of Mines, has resigned to accept a position on the technical staff of an oil company.

Captain J. P. Hodgson, general manager of the Morenci branch of the Phelps Dodge Corporation, has just returned to Morenci, from a visit to various mining properties in Alaska.

H. I. Jensen, of Brisbane, Queensland, Australia, recently returned to Brisbane from a commission to examine oil prospecting country in South Australia held by a strong Victorian company. Dr. Jensen is a graduate of Sydney University, New South Wales, and among the scholastic honors won by him was the Syme prize for geological research at the Melbourne University, Victoria. From 1912 to 1916. he was Director of Mines

H. I. Jensen

and Chief Government Geologist in the Northern Territory, Australia, and for the following five years was one of the staff of geologists forming the Geological Survey of Queensland. Since that time he has been in private practice, and has had commissions for geological work not only in Queensland and other Australian states, but also in New Caledonia.

General John C. Greenway, general manager of the Calumet & Arizona, has been offered the nomination for Governor of Arizona on the Democratic ticket. He refused it.

W. L. Remick has resigned his position in the mining department of the Carnegie Institute of Technology to become associate editor for the Keystone Consolidated Publishing Co.

Felix McDonald, superintendent of mines, and **Clyde Weed,** assistant to the general manager of the Inspiration Consolidated Copper Co., were recent visitors in the Jerome district, in Arizona.

William J. Loring has been appointed chairman of the gold-producers' conference, which will meet during the annual convention of the American Mining Congress, at Sacramento, Calif., Sept. 29 to Oct. 4.

E. H. Wolff, formerly vice-president and manager of the Illinois Zinc Co., and who recently established himself in the Joplin-Miami district, investing in mining properties there, has opened a brokerage office in Joplin.

T. T. Read, safety service director for the U. S. Bureau of Mines, is completing a six-weeks' field trip during which he has conferred with many state mine inspectors. His trip carried him as far West as Salt Lake City and Denver.

Frank Oliver has accepted the position of manager for the Nevada Florence Exploration Co., which company has a lease on part of the Florence ground above the 5th level. He will also act as consulting engineer for the Florence Goldfield Mining Co.

Charles Ferry, vice-president in charge of sales of the Nichols Copper Co. since 1919, has been elected a director of the company to succeed **Dr. John B. F. Herreshoff,** resigned. Mr. Ferry was formerly with the Bridgeport Brass Co., Bridgeport, Conn. Dr. Herreshoff has been with the Nichols Copper Co. since its organization in 1905, and with the Nichols Refinery since early in the 90's. He has been elected an honorary vice-president.

Prof. Thomas M. Bains, Jr., who has been in the Mining Department of the University of Illinois, has accepted a position as associate professor of mining at the Colorado School of Mines and will begin his duties in September. Mr. Bains is a man of wide experience and training and is a recognized authority on metal mining. He is a graduate of Cornell and specialized in mining at the University of Columbia. For four years he was in the field doing practical work. Most of this time was spent in California, old Mexico, and British Columbia. Professor Bains was a faculty member of Case School of Applied Science, University of Minnesota, and Missouri School of Mines before going to the University of Illinois, from which institution he goes to Colorado.

Obituary

Walter E. Soest, whose death was recorded in a recent issue, was a graduate of the School of Mines at Rolla, Mo. He had been in the employ of the El Potosi Mining Co. for the last fourteen years and was returning from an inspection trip when he was killed in an automobile accident. Mr. Soest had charge of the flotation experimental plant of the El Potosi Mining Co., and in that position had rendered the company invaluable service. He is survived by a wife and three sons.

Prof. John James Stevenson, professor emeritus of geology at New York University, died on Aug. 10, 1924, in New Canaan, Conn. Professor Stevenson was a graduate of New York University, where he received his Bachelor of Arts, his Master's, and his Doctor of Philosophy degrees. He held an LL.D. from Princeton and from Washington and Jefferson. Following his studies in New York University he became professor of chemistry and natural history at West Virginia University and soon after was called to the faculty of his alma mater. He was made professor emeritus of geology in 1909. Professor Stevenson was a member of geological societies in all parts of the world and had written extensively on scientific subjects. He was eighty-three years old. Mrs. Stevenson survives him.

Societies, Addresses, and Reports

Arizona's School of Mines

By G. M. Butler, Director

THE announcement that Dr. Frederick L. Ransome, long in charge of the sections of Western Areal Geology and of Metalliferous Deposits with the U. S. Geological Survey, had resigned from the Survey and accepted the position of Professor of Economic Geology in the University of Arizona attracted much attention. The interest aroused was accentuated by the more recent announcement that Professor J. B. Cunningham, head of the Department of Metallurgy in the Michigan College of Mines, would leave that institution at the end of the fall quarter and join the faculty of the University of Arizona to assist T. G. Chapman, professor of metallurgy and ore dressing, who has been with the institution for several years. When it became known that Dr. Charles Schuchert, of Yale, had agreed to deliver a twelve-weeks' series of lectures on Advanced Stratigraphy at the university next winter, many people interested in mining engineering education expressed a desire to know just what kind of a mining school is being developed in the Southwest. In answer to these inquiries, this brief statement of facts has been prepared.

Dr. C. H. Marvin, when he accepted the presidency of the university, realized that it was impracticable to attempt to do the best possible work along all lines, and he and the members of the Board of Regents determined to do everything necessary to attain to a position of pre-eminence in those subjects that, because of the location of the institution, can be taught more advantageously at Tucson than elsewhere. Among such courses are advanced Spanish, astronomy, American archaeology, and semi-arid agriculture. Since the university is situated in a state that has a more valuable production of metallic minerals than any other, it was but natural that they should decide to attempt to build up in Arizona the greatest college of mines in the country. In furtherance of this intention, the salary scale was raised to such an extent that it was possible to attract and retain the best teachers of mining engineering, metallurgy, ore dressing, and geology; and funds were made available for the purchase of such equipment for the teaching of these subjects as could not be surpassed elsewhere. Furthermore, determined efforts were initiated to build up a great research library in the branches mentioned. This fall the first unit of a magnificent new library building will be completed.

The employment of Dr. Ransome and Professor Cunningham is in harmony with these plans, as was the engagement last year of Dr. A. A. Stoyanow to handle the work in paleontology, stratigraphy, and petroleum geology, and the appointment of Dr. F. N. Guild to be head of the Department of Geology, and to teach microscopic mineralogy, petrography, and advanced crystallography. Dr. T. S. Lovering, of the University of Minnesota, has also been appointed instructor in geology and mineralogy, and all phases of mining, metallurgy, and geology will in the future be handled by specialists who are recognized authorities in their particular fields.

The university authorities have no desire to build up an especially large school, and intend to place the emphasis upon the quality rather than the quantity of the product. The entrance requirements are as rigid as prevail in any university in the country, and determined attempts are made by the college to eliminate at an early date all students who are not thoroughly qualified to succeed in their chosen professions.

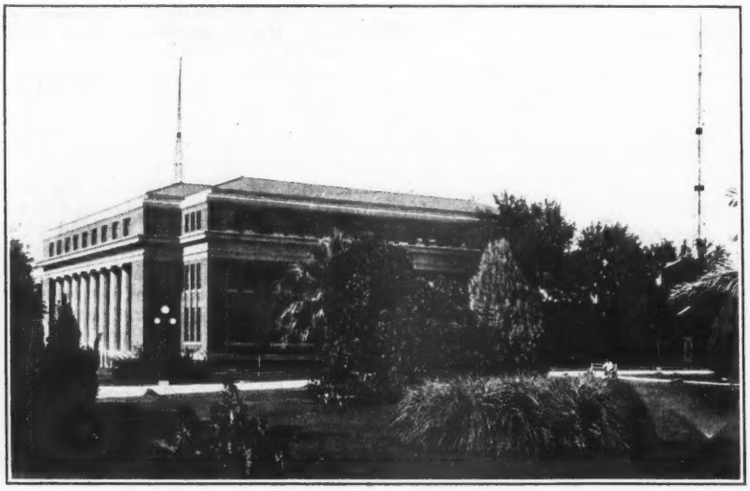
It is believed that full justice cannot be given to large classes of students in highly technical subjects, and every effort is made to keep the enrollment moderate. The existence of comparatively small classes makes it possible for instructors to give the students all the individual instruction and help they may need. Furthermore, most of the classes can be taught by experienced specialists instead of young instructors, and the students derive invaluable benefits from their close association with men of recognized ability. The fact that instructors are expected to teach only in the line of their specialties gives them much time for research and for directing the work of graduate students, and it is believed that no college of mines offers better opportunities for graduate work, especially in ore dressing and geology, in which the equipment is particularly complete.

The college authorities are now perfecting a plan for a co-operative arrangement with the industries, which will enable the students to obtain varied, practical experience during their summer vacations. This plan involves the transfer of students from one job to another and gradual advancement as they demonstrate their ability; and it will enable the college authorities to determine to what degree the students possess those qualities other than technical ability upon which their success is so largely dependent.

Another feature that will be put into operation next year is the delivery of a series of lectures by mining men and geologists who have had long and very successful practical experience, and who will give to the students the practical man's viewpoint as a supplement to their theoretical training. The many trips taken throughout the year to great mines, mills, smelters, and points of geological interest tend to emphasize the practical application of the studies pursued at Tucson, but it is believed that this emphasis will be made even stronger through the delivery of the lectures mentioned. The following men have signified their willingness to deliver from one to three or four lectures during the coming winter:

P. P. Butler, smelter superintendent, Copper Queen Branch of the Phelps Dodge Corporation; Arthur Crowfoot, mill superintendent, Morenci Branch, Phelps Dodge Corporation; Val DeCamp, assistant mine superintendent, United Verde Copper Co.; W. G. McBride, general manager, Old Dominion company; W. J. Mitchell, chief geologist of the Cananea Consolidated Copper Co.; Chas. A. Mitke, prominent mining engineer of Bisbee; D. M. Rait, assistant mine superintendent, Calumet & Arizona Mining Co.; Dr. Louis Reber, chief geologist, United Verde Copper Co.; Guy Ruggles, mine superintendent, Inspiration Consolidated Copper Co.; J. M. Samuel, head of the Investigation Department, Copper Queen Branch of the Phelps Dodge Corporation; Gerald Sherman, engineer, Phelps Dodge Corporation.

The college also intends in the near future to offer a graduate course to men who plan to become executives in the mineral industries. This course will be open only to individuals who have earned their undergraduate mining degrees in strong institutions, who have had several years of practical experience, and who have demonstrated those personal qualities necessary for success in executive positions.



Mining Building, University of Arizona, at Tucson, Ariz.

Recent Technical Publications

Reviews, Abstracts, and References

Ventilating the Mine

Theory and Practice of Mine Ventilation. By Thomas Bryson. Longmans, Green & Co., New York. Price $3.

Although this little volume has been written to cover British colliery practice almost exclusively, the major portion of the text discusses and outlines principles which are the same the world over, regardless of what minerals or metals are being mined. Composition of the atmosphere and mine air, harmful gases encountered in mining, resistance to the flow of air, measurements of gases, selection of proper fans and their mechanical details, are some of the topics developed in the book. Those sections which are theoretical in treatment are presented in simple language, with numerous practical examples to show the application of theory in specific cases. Metal miners will find the work sound and helpful. One omission is to be noted, however—that is, failure to mention the kata-thermometer and the use to which it has been put in improving working conditions underground. This is strange in view of the fact that the kata-thermometer is a British invention and has been principally used in British mines. Probably it has not yet been applied to coal mines, which may explain the lack of attention given it by Mr. Bryson.

F. E. WORMSER.

Redistillation of Zinc—The American Institute of Mining and Metallurgical Engineers, 29 West 39th St., New York City, has issued a 22-page paper by Kurt Stock, on "Redistillation of Zinc." This paper describes the process developed by the Bartlesville Zinc Co. and used during the World War in transforming ordinary grades of zinc to the lead- and cadmium-free variety demanded for war purposes. The method is no longer used, as sufficient high-grade zinc to meet the demand is now produced from pure ores and by electrolytic methods.

Michigan Mineral Products — The Michigan Geological and Biological Survey, Lansing, Mich., has recently published Publication 34, Geological Series 28, the "Mineral Resources of Michigan," by R. A. Smith. This is a book of 146 pages giving the production and value of Michigan's mineral products for 1922 and prior years, brief descriptions of the various deposits, and a directory of all metal mines and non-metallic producers. Financial statements of the various Michigan copper companies are included.

Air-lift Pumps—The engineering department of the University of Wisconsin has been conducting an investigation into air-lift pumps, the results of which are presented in U. of W. Bulletin of the Engineering Series, Vol. IX, No. 4, written by C. N. Ward and L. H. Kessler.

Alberta Geology — The Geological Division, Province of Alberta, Edmonton, Alta., has published a 75-page bulletin entitled "Geology Along the Blackstone, Brazeau and Pembina Rivers, in the Foothills Belt, Alberta," by John A. Allan and Ralph L. Rutherford. (Price 75c.) In this district, coal deposits are of chief interest.

The Rand Gold Industry—"The Gold of the Rand," a book of 135 pages, has been published for the information of those wishing better to understand the importance of this great South African industry, its achievements and objects, how the mines are operated, and what they mean to the country. The Transvaal Chamber of Mines is the sponsor, and copies may be obtained on request from the South African Industrial News Service, P. O. Box 1162, Johannesburg, the Transvaal, South Africa.

Copper Matte—"The Constitution of Copper Mattes," by F. H. Edwards, appears in the May Bulletin of the Institution of Mining and Metallurgy (Cleveland House, 225, City Road, London, E. C. 1, England). It is of 19 pages, illustrated with numerous photomicrographs. The cumulative results of the author's work indicate that the copper sulphide-copper system forms a series of solid solutions, with the two branches of the melting-point curve meeting at a minimum of 940 deg. C. There is a strong evidence in support of the formation of a compound within the solid range and to be found in limiting composition of the mattes. No trace of eutectic structure is observed in any of the samples of mattes. Copies of the paper may be obtained for 1s. from the offices of the Institution.

Iron Ore Concentration—The Department of Mines, Mines Branch, Ottawa, Canada, has issued No. 16 of the Memorandum Series, 12 pages, entitled "Experimental Tests on the Beneficiation of Canadian Iron Ores," by W. B. Timm, obtainable on request. The bulletin is a brief summary of the tests made on a dozen or more iron ores by wet magnetic separation for the most part, though hand cobbing, jigging, and tabling were done on some lots. The character of the ore is given in each case, with analyses of the crude ore, concentrate, and tailing, and a paragraph of general conclusions.

The *Mining Journal-Press* has on hand two or three hundred reprints of the flow sheet of the Sullivan concentrator of the Consolidated Mining & Smelting Co., at Kimberley, B. C., which was issued as a supplement to the issue of Sept. 15, 1923. Should any of our readers desire one or more of these, we will be pleased to send them on receipts of stamps to cover the postage. They might be used for distribution to students of ore dressing in mining schools.

Among the books recently received, and which we hope to review soon are: "Tested Methods of Mineral Analysis," by B. T. Kitto, a small English book which we note is given rather unfavorable reception by a reviewer in *The Mining Magazine* for July; "Foibles and Fallacies of Science," a Van Nostrand book about astrology, the transmutation of metals, perpetual motion, divination, and other such interesting subjects, which we hope to read during our vacation; a little book of "Popular Research Narratives," published by the Engineering Foundation, which also ought to be good summer reading for the tired mining engineer; "Practical Mathematical Analysis," by a German professor, H. von Sanden, which looks almost as abstruse as some of the Japanese bulletins that come to our desk; "A Tested Method of Laboratory Organization," a practical looking little English book; and "Lead, the Precious Metal," written by O. C. Harn, the advertising manager of the National Lead Co. As a matter of fact, we have just finished reading the last-named book and can hardly get away from the fact that world wouldn't be much of a place to live if it were not for lead. No wonder it is now very scarce, but as it seems to be the last step in breaking down radium, thorium, and uranium, we should be assured of at least a small supply for some time to come.

The book "In and Under Mexico," written by a Yale graduate who spent a year or so at Pilares and wrote up his impressions, seems to have aroused a good deal of talk, and the general opinion seems to be that the author was not entirely just in all that he said, and should not have made fun of some of the things that he did. This is another book that we are saving for our vacation. We have often thought that the out-of-the-way mining camp offers a wonderful locale for an entertaining book, but neither mining engineers, nor their wives, seem to have done much writing of this kind. Probably they feel, as we have ourselves felt, that to write a really interesting book would get one into so much hot water that one would have to accept a ten-year contract in China or somewhere until the excitement blew over.

E. H. R.

Patents

Petroleum—No. 1,500,186. July 8, 1924. J. D. Gibbs, Louisville, Ky. A feeding mechanism for oil drilling.

No. 1,501,536. July 15, 1924. Loues Friedman, Muncie, Ind., and David Wallace, Tulsa, Okla. A flowing device for oil wells.

No. 1,502,105. July 22, 1924. J. W. Loy, Burnett, Calif., assignor of one-half to F. M. Fishback, Long Beach, Calif. A tool for removing casing from wells.

No. 1,502,106. July 22, 1924. W. H. Lyne, Houston, Texas. A pipe connection and valve, in connection with the casing of oil and gas wells.

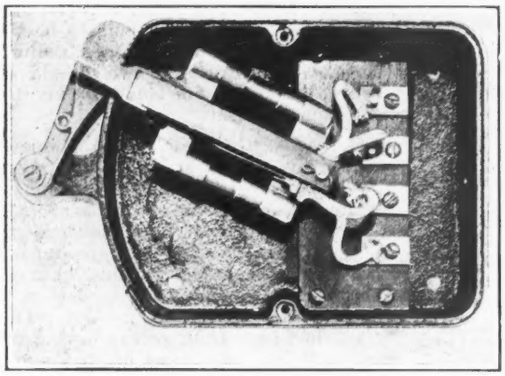
No. 1,502,161. July 22, 1924. C. G. Scharpenberg, Bakersfield, and L. G. Gates, Whittier, Calif., assignors to Standard Oil Co., San Francisco. A crown block for well-drilling apparatus.

No. 1,502,179. July 22, 1924. E. V. Crowell, Tulsa, Okla. A means for sealing a well before opening the bore into a productive stratum.

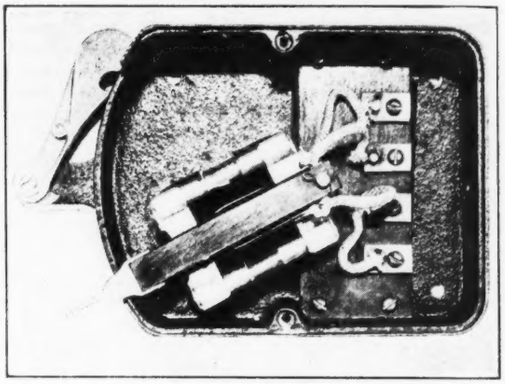
New Machinery and Inventions

Mercury Contactor Assures Safety in Shop Work

A device which is said to have advantages over the ordinary type of contactors or switches has been developed by a Wisconsin manufacturer. Wherever any form of switch is required, this device is applicable. It is said to give the advantage of perfect contact, with the assurance that it never fails in performance. It does not require cleaning or adjusting. The device, which is made by the Absolute Con-Tac-Tor Corporation, Beloit, Wis., consists merely of a glass tube having electrodes near one end with a gap between them. In the tube is a certain amount of mercury. When the tube is tilted so that the mercury falls away from the electrodes the circuit is broken, but when tilted so that the mercury covers the ends of both electrodes, an absolute contact is formed, completing the circuit. An inert gas in the tube prevents oxidation or combustion within the tube.



The switch on the left is closed, the mercury being in the lower ends of the tubes. The switch on the right is open, the mercury now being in the opposite ends of the tubes, breaking the circuit.



The tubes are standardized so that they will snap into ordinary fuse clips and are mounted on carriages having bearing pinions placed in any desired position, according to the way in which the device is to be operated.

A relay contactor operates without tilting. Floating on the mercury is a hollow cylinder of iron lined with an inner sleeve of porcelain. The gap between the electrodes is within the cylinder. Fixed around the tube is an electro-magnetic coil so placed that, when its own circuit is established, its action draws down instantly the iron cylinder, displacing the mercury and forcing it up through the center of the cylinder, thus enveloping the tips of both electrodes and completing the circuit.

Improved Belt Conveyor Carrier Patented

Patents have recently been granted on improvements in belt conveyor carriers made by the Stearns Conveyor Co., of Cleveland, Ohio. They cover what are known as the Philips belt conveyor carriers. The shell of the pulley is made of pressed steel. Edges are rounded to avoid cutting the belt.

Inside of the shell and held firmly in tapered ends is a one-piece tube, chambered out to receive two anti-friction bearings. Inside of the bearings is a hardened steel shaft held stationary on brackets. Thus there is a space between the shaft and tube for a grease chamber, the bearings and grease-retaining washers forming the ends of the chamber.

Greased is forced into the chamber and bearings at high pressure through the hollow ends of the shaft. It is the contention of the builders that this arrangement makes it possible for enough grease to be forced into the equipment to meet the requirements of a period of from six months to a year.

A Support for Worm Shafts

A worm box has just been developed by the W. A. Jones Foundry & Machine Co., of Chicago, which provides an accurate and rigid support for the worm shaft and holds a liberal supply of oil in which the worm operates. Finished thrust washers at both ends of the worm consisting of two steel and the center one of hard fibre are also provided. The bearings are babbitted and bored, and also faced on ends. These boxes are made in standard sizes to suit standard cut steel worms made by the company. Both the boxes and gears are covered by Catalog No. 29, entitled "Jones Gears."

Filtration of Boiler Feed Water

Spring, well, river, or city water used for feed purposes in power plants frequently contains chemically combined elements and finely divided particles of clay, sand, and organic matter in suspension, all of which are injurious to boilers. A substance such as clay, if allowed to enter the boiler, will bake and impair the efficiency of heat transmission.

Internal corrosion, whether uniform or occurring as pitting or grooving, is the most destructive force to which boilers are subjected. It shortens life by eating away the bolts, plates, and rivet heads, and if not checked is likely to result in dangerous explosions. Organic matter in sewage or in water from swamps and peat bogs often becomes corrosive on heating. It causes foaming, which makes it difficult to determine the level of the water, leading to the burning of tubes and plates. It may also cause the boiler to prime, and the engine may be wrecked by water carried over to the cylinder.

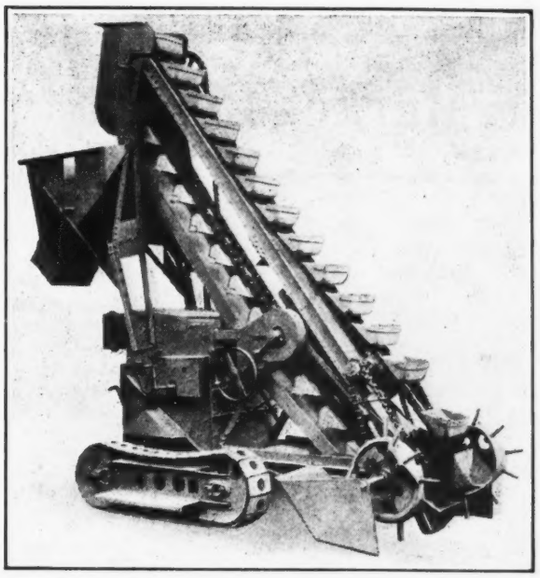
The condensate from engine exhaust steam may contain the lubricating oil fed to the engine. This, together with other impurities, should be removed before the water is returned to the boiler. A new grease extractor and water filter comes in a compact unit using Turkish toweling. Three types are available: (1) Double; (2) single, with bypass, and (3) single, without bypass. The double type provides the greatest protection, as one filter may be bypassed for cleaning while the other is in service. The cylinders are of convenient size for easy handling by one man. The filtering stockings can be readily pulled off the cylinders for washing, and are easily and quickly replaced. The cylinders are made of gray cast iron, and the baskets of heavy cast brass. Bulletin 108 contains complete information, obtainable from C. F. Braun & Co., Alhambra, Calif.

A New Portable Loader With Tractor Tread

Portable bucket-type loaders are now in practical use for handling crushed stone, sand, gravel, ashes, earth, coke, salt, fertilizer, and many other loose materials, besides coal. A new loader, designed so as to have exceptional strength, and the ability to move over soft, rough, or uneven ground, has been developed by the Jeffrey Manufacturing Co., Columbus, Ohio. It is known as the "Tanktred" loader. In it, the three-wheel chassis has been replaced by a crawler mounting and the lower end of the boom has been fitted with effective clean-up device and scoop. This loader has a capacity of 1½ to 2 cu.yd. per minute, and will handle rough material, like crushed stone, that will pass through a 3½ in. ring, or coal up to 8 in. lump.

The framework of the boom is built of wood and steel, so as to provide strength and elasticity. The buckets are 18 in. long, of malleable iron, with high backs and renewable steel digger edges. To receive the discharge from the elevator buckets, the top of the boom may be fitted with a swivel spout, to give as much as 11 ft. clearance from the ground. Or, in place of the swivel spout, a measuring, or batch hopper, with valve in the bottom, and having a capacity of about 21 cu.ft., may be substituted.

The crawler tread proper consists of heavy steel plates, bolted to a chain made of cast-steel side bars, hardened-



In this portable loader, a crawler mounting has been provided. The tread consists of heavy steel plates bolted to a chain made of cast-steel side bars, and pins and knuckles of hardened steel.

steel knuckles, and hardened-steel pins. The tread sprockets are of heavy cast steel. The thrust from the under side of the tread is taken by chilled rollers, placed in proper position. The main weight of the machine is carried on these crawlers by a three-point suspension, to allow for passage over rough and uneven ground.

The clean-up device consists of revolving spiders, having hardened-steel pin inserts, and of a plate-steel scoop. The pin inserts are so placed as thoroughly to loosen compact material and carry it forward into the path of the buckets. This method insures a full load in each bucket, even when working in shallow piles.

The driving mechanism is mounted in a rigid steel and cast-iron, self-contained frame, which in turn is mounted on the framework proper of the machine. A heavy steel shelf supports the power unit, so that all gears are in line and cannot get out of proper mesh. Gears are steel with cut teeth. All parts are interchangeable. The entire driving unit is inclosed in a steel plate housing of built-up shingle effect, to keep out dirt.

Operation is easily controlled by levers conveniently located. Propelling, steering, and operation of the elevator are accomplished through multiple-disk clutches. The treads are controlled by brake mechanism on the differential shaft, making it possible to turn the machine on the center of either crawler as a pivot.

Two speeds, both forward and in reverse direction, are provided: the fast speed, 50 ft. per minute, for moving the machine from pile to pile; the slow speed, about 2 ft. per minute, for feeding into the material.

Locomotive Storage Batteries Used During Shutdown

The Madison Coal Corporation, at Glen Carbon, Ill., owning one of the largest fleets of Exide-Ironclad battery-equipped locomotives in the country, recently found that, owing to a shutdown of one of its mines, sixteen sets of batteries would not be required for locomotive work. Idle equipment is generally a liability, but in this case the batteries were put to work in an unusual way.

In many mines, certain work must go on whether or not they are in operation. Pumps must be operated, ventilation equipment must be kept going, lights here and there are needed. In the sixteen sets of batteries an abundance of electrical energy was available. All that was required to utilize this energy was proper connection of the cells in series multiple to obtain the required voltage. The batteries were thus connected, and this power was harnessed to the machinery which had to be kept running during the shutdown.

The company states that this unique application of storage batteries has made it possible to close down its steam plant for twenty days at a time, effecting a saving of hundreds of dollars.

The batteries furnished over this period of time sufficient current to operate all pumps and ventilation equipment, and for lighting, before requiring recharge. It is quite reasonable to believe that other companies will be able to make similar use of their locomotive batteries during shutdown periods.

Trade Catalogs

Centrifugal Pumps—Bulletin 1632 G, covering centrifugal pumps and pumping units, has just been issued by the Allis-Chalmers Co., Milwaukee, Wis. It is a revised edition of a previous bulletin. In its fifty-eight well-illustrated pages, the various types and applications of these pumps are described. With reference to mine pumps the company points out that its multi-stage pumps for mine service are often made of bronze where acid water is to be handled. It states that an acid-resisting bronze of longer life than ordinary bronze possesses has been developed. In some cases the interior of the pump is painted with an acid-resisting enamel.

Refractory Cement—"Thermolith, the All-Temperature Fire Cement" is the title given to a 35-page pamphlet just issued by the Harbison-Walker Refractories Co. It is a comprehensive treatise on the value and application of thermolith in the various industries in which it is used, together with proofs and tests. It includes scientific data relative to the performance of thermolith. This handbook is intended to help prospective users of thermolith ascertain how this material may best be used in their specific practices.

Tanks and Pipes.—Catalog No. 24 issued by the National Tank & Pipe Co., Portland, Ore., contains detailed information on essential equipment for mining and metallurgical work, with special reference to standard wood tanks, leaching vats, false bottoms, launders, agitators, storage vats, and acid sumps used in cyanide and copper-recovery plants. Tables of capacities and other information in handy form have been added, and an index makes the volume a useful book of reference for the engineer.

Electro-Sherardizing — Bulletin No. 40 of the Steere Engineering Co., of Detroit, Mich., is entitled "Electro-Sherardizing." The process of depositing metallic zinc on the surface of iron or steel by electrolytic means is known as sherardizing. This process as employed by the Steere Engineering Co. is described with numerous illustrations in the 12 pages of this pamphlet.

Hammer Drill—The Little Giant electric hammer drill, manufactured by the Chicago Pneumatic Tool Co., is described in bulletin No. 896, just issued. This drill it is stated is extensively used for drilling concrete and soft stone as well as for light chipping of metals. It will operate interchangeably on direct or alternating current.

Wrought Pipe.—No. 10 of the "National" Bulletin, published by the National Tube Co., Pittsburgh, Pa., has come to hand. It includes articles entitled "National Pipe for Power Piping"; "Specific Advantages of National Pipe and Power Plant Service," and "Special Uses."

Speed Transformer—Bulletin T 220, of the Hill Clutch Machine & Foundry Co., Cleveland, Ohio, describes the company's "Industrial Type" speed transformer. This is a speed-changing device for use in connection with elevator drives in mills and other plants.

Explosives.—A folder sent out by the Atlas Powder Co., Wilmington, Del., covers blasting supplies, such as blasting caps, including electric caps, safety fuse, blasting machines, cap crimpers, and the like.

Roller Bearings.—Bulletin 1015 issued by The Hyatt Roller Bearing Co., Newark, N. J., discusses the application of roller bearings to conveyors. It has twenty-four well-illustrated pages that contain much useful data.

Steam Shovels — Circular No. 245 issued by the Osgood Company, Marion, Ohio, describes the application of traction wheels to railroad-type steam shovels.

Compressors.—The Bury Compressor Co., of Erie, Pa., has issued Supplement 407, covering air and gas compressors and vacuum pumps of various types.

The Market Report

Daily Prices of Metals

Aug.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
7	13.125	51.50	52.00	7.50	7.35@7.45	6.10@6.15
8	13.125@13.25	51.625	52.125	7.50	7.40@7.45	6.05@6.10
9	13.125@13.25	51.625	52.125	7.50	7.40@7.45	6.10@6.15
11	13.25@13.375	51.625	52.125	7.75	7.60	6.15
12	13.375	51.125	51.625	7.75	7.60@7.65	6.15@6.175
13	13.375	51.125	51.625	7.75	7.65@7.70	6.175@6.20
Av.	13.260	51.438	51.938	7.625	7.525	6.138

*These prices correspond to the following quotations for copper delivered: Aug. 7th, 13.375c.; 8th and 9th, 13.375 @ 13.50c.; 11th, 13.50 @ 13.625c.; 12th, and 13th, 13.625c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Aug.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
7	63 7/8	64 7/8	68	256	256 1/4	32 1/4	31 5/8	32 3/8	32 3/8
8	63 5/8	64 1/2	67 1/2	255	255 1/4	31 7/8	31 3/8	31 7/8	32
11	63 7/8	64 7/8	68	253 3/4	254 1/4	32	31 5/8	31 5/8	31 7/8
12	63 5/8	64 5/8	67 3/4	250 3/4	251 1/2	32 5/8	32 1/4	31 7/8	32 1/8
13	63 5/8	64 5/8	68	249 3/4	250 1/2	33	32 1/2	32 7/8	32 1/8

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Aug.	Sterling Exchange "Checks"	Silver		Gold London	Aug.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
7	4.46 7/8	68 1/2	34 3/8	92s 6d	11	4.55 1/2	69	34 1/16	90s 7s
8	4.53 1/4	69 1/8	34 3/8	91s 4d	12	4.54 3/4	68 5/8	33 13/16	90s 8d
9	4.51 1/8	68 3/4	34 1/4	..	13	4.53	68 3/4	34 1/16	91s 1d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Non-Ferrous Metals Show Further Strengthening

New York, Aug. 13, 1924.—Prices of all the major non-ferrous metals have continued the advance of recent weeks. Silver during the last week again registered a new high for the year, a feature of the market being the entrance of Germany as a purchaser for coinage purposes. Consumers have taken heavy amounts of lead and moderate quantities of copper and zinc were also bought. Buying of tin has been good. Speculation in the metals seems to be more prevalent in copper and tin than in any of the other metals of the group .

Copper Moves to Higher Price Levels

Copper has risen one-quarter cent in value during the last six business days, bringing the market to 13⅝c. delivered. The heaviest amount of copper was sold Monday and Tuesday at prices ranging from 13½ to 13⅝c. Earlier in the week the metal was sold for 13⅜c. delivered, the lowest for the period. Inquiry has been fine from both domestic and foreign consumers. Some companies have been satisfied with their export orders and have not entered the domestic market to any great extent. Germany has been an especially active purchaser. Speculative influences seem to be at work abroad, both among dealers and fabricators. One factor that has helped the market to rise has been the steadiness of the London market coupled with the improvement in the value of the pound sterling. Today, copper can be obtained in this market for 13⅜c. delivered, but several producers are asking 13⅝c.

Heavy Tonnages of Lead Sold

On Monday, Aug. 11, the American Smelting & Refining Co. advanced its official contract price of lead from 7.50 to 7.75c. per lb. New York. The outside market is also at higher levels. Advancing prices have not had any appreciable effect upon the appetite for lead of manufacturers. If the amount of lead sold during the week is any accurate gage, consumers have been very hungry indeed for the metal. All classes of buyers with the exception of storage-battery makers bought large quantities, and the demand is still unsatisfied. Whereas one producer has been selling for August shipment, another has been booking September business chiefly. In St. Louis the market rose during the week from 7.35c. last Thursday to 7.70c. today, with at least one producer asking 7.75c. The New York and St. Louis markets are close together again. New York has not figured very prominently as a basing point for sales, most of them being contracted on a St. Louis basis. The London market is firm, and a good consuming demand is reported from Europe.

Zinc Declines and Recovers Strongly

Sales of Prime Western and High Grade zinc have been larger then usual during the week. Galvanizers have bought Prime Western mainly for prompt shipment or delivery in August. Their stocks are generally thought to be low. The low point for the week was 6.05c. last Thursday, but the market did not remain long at that level and rose steadily, bringing the price to 6.175 to 6.20c. today, at which level a large tonnage was placed. High grade is being sold for 8 to 8¼c. delivered.

Stocks of zinc showed a small increase in July, according to the statistics of the American Zinc Institute. On July 1 they were 49,684 tons, compared with 42,364 on June 1; production for July was 42,913 tons, compared with 43,142 in June; shipments amounted to 39,892 tons in July, compared with 36,122 in June. Stocks on hand July 31 totaled 52,705 tons, compared with 49,684 on June 30.

Tin Market Irregular

Buying of tin on the part of domestic consumers has been excellent, and the price has therefore been responsive and

advanced to 52.125c., but a slight recession has occurred since. Speculative activity is still noticable in the market. Arrivals of tin to Aug. 11 were 2,125 tons at Atlantic ports and 75 tons at Pacific ports.

Circulation Statement of United States Money

On Aug. 1 the following stock of money was held in the United States: Gold coin and bullion, $4,517,483,901; gold certificates, $1,257,459,419; standard silver dollars, $503,946,769; silver certificates, $412,482,114; subsidiary silver, $277,604,580; United States notes, $346,681,016; Federal Reserve notes, $2,271,118,230; Federal Reserve bank notes, $10,226,170; National bank notes, $777,087,589; total, $8,704,148,255.

Foreign Exchanges Have a Reaction

After advancing steadily, the foreign exchanges experienced sharp declines on Tuesday, when francs were quoted at 5.54c., lire 4.50c. and Canadian funds in New York ¼ per cent discount.

Silver Higher, Steady, and Firm

Aug. 8 brought another high quotation for the year, of 69¼c., although prices have reacted slightly since. The market is steady on continued demand from the Far East and the Continent. On Aug. 12 Germany effected a contract for the purchase in this market of four million ounces at the market price. The sale was negotiated by the four American companies that participated in the recent sales of silver to Poland. The German allotment will be used for coinage purposes.

Mexican Dollars: Aug. 7th, 52⅜c.; 8th, 53⅛c.; 9th, 52⅞c.; 11th, 53⅛c.; 12th and 13th, 52⅞c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 26½@27c. London, £125 per long ton.

Antimony—Per lb.:
Chinese brands, 9⅛c.
W. C. C. brand, 11½c.
Cookson's "C" grade, 11⅝@11⅞c.
Chinese needle, lump, nominal, 8½@9c.
Better consuming interest.

Bismuth—$2.45@$2.50 per lb. London, 10s.

Cadmium—60c. per lb. London, 2s. 9d.

Cobalt—$2.50@$3 per lb. for spot.

Iridium—$260@$270 per oz.
Iridium alloyed with platinum, $280 @$286.

Nickel—27c. per lb. for 99 per cent virgin metal. London, £135 long ton.

Osmiridium—Crude, $58.50 per oz.

Osmium—$95@$104 per oz.

Palladium—$78@$83 per oz. Crude, $60 per oz.

Platinum:
Refined, $120 per oz.
Crude, $113@$114.
Market dull.

Quicksilver—$72 per 75-lb. flask. San Francisco wires $71.85; London, £13.

Rhodium—$85@$90 per oz.

Ruthenium—$40@$45 per oz.

The prices of Germanium Oxide, Magnesium, Molybdenum, Monel Metal, Radium, Selenium, Tellurium, Thallium, Tungsten and Zirconium are unchanged from the prices given in the Aug. 9 issue.

Metallic Ores

Chrome—$19@$22, depending upon grade and source. Nominal.

Manganese—42@46c. per long ton unit, seaport, c.i.f. Nominal.

Molybdenum—80c. per lb. of MoS_2 for 85 per cent concentrates. Nominal.

Tungsten Ore—Per unit, N. Y.:
High-grade wolframite, $9@$9.25.
High-grade scheelite, $9.25.
Ordinary grades, $8.25@$8.50. Nominal.

Iron Ore, Magnetite, Tantalum, and Vanadium are unchanged from Aug. 9 quotations.

Zinc and Lead Ore Markets Higher

Joplin, Mo., Aug. 9, 1924

Zinc Blende

High	$44.35
Premium, basis 60 per cent Zn	$42.@$43.50
Prime Western	$41.@$42
Fines and slimes	$40.@$38
Average settling price, all	$40.88

Lead Ores

High	$94.90
Basis 80 per cent lead	$100
Average settling price, all	$86.83

Shipments for the week: Blende, 14,366 tons. Value, all ores for the week, $742,170.

The price of $100 was made for lead ore deliveries beginning next week, and it is reported some contracts will continue until the end of the year Settlements are still being made on ore contracted for on $80 to $90 basis, and will continue for several weeks.

One company came in strong for zinc ore on Wednesday and was freely contracting for a large tonnage on $42 basis, Prime Western. Other companies followed, and on Thursday night it was estimated 7,000 tons had been contracted, over half of it on a basis of $42, while other tonnage contracted on the market price will also bring $42 basis on settlements.

Platteville, Wis., Aug. 9, 1924

Zinc

	Per Ton
Blende, basis 60 per cent zinc	$43@$43.75

Lead

Basis 80 per cent lead $95

Shipments for the week: Blende, 722 tons; lead, none. Shipments for the year: Blende, 18,657; lead, 690 tons. Shipments for the week to separating plants, 1,078 tons blende.

Non-Metallic Minerals

Asbestos:
Crude No. 1—$300@$400.
Crude No. 2—$150@$225.
Spinning fibers—$90@$150.
Magnesia and compressed sheet fibers —$50@$90.
Shingle stock—$50@$60.
Paper stock —$25@$40.
Cement stock—$15@$20.
Floats—$6@$12.
All per short ton, f.o.b. mines, Quebec, tax and bags included.

No. 1 Rhodesian crude, $325; No. 2, $200 per short ton, c.i.f. New York.

Overproduction in the industry. Market weak; demand not up to scratch.

Amblygonite, Barytes, Bauxite, Beryl, Borax, Celestite, Chalk, China Clay, Diatmaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Gypsum, Ilmenite, Lepidolite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Ozocerite, Phosphate, Potash, Pumice, Pyrites, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli and Zircon are unchanged from Aug. 9 prices.

Mineral Products

Arsenious Oxide (white arsenic)—7⅞c. per lb.

Copper Sulphate—4.75c. per lb. for domestic in carload lots.

Potassium Sulphate, Sodium Sulphate, Sodium Nitrate and Zinc Oxide are unchanged from Aug. 9 prices.

Ferro-Alloys

Ferrochrome, Ferromanganese, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and Ferrovanadium are unchanged from the prices given in the Aug. 9 issue.

Metal Products

Copper — Sheets, 20⅜c. base; wire, 15½c.

Lead Sheets—Cut, 11c.; full, 10¾c. per lb.

Nickel Silver—18 per cent Grade A sheets, 26½c.

Yellow Metal — Dimension sheets, 18c.; rods, 15c.

Zinc Sheets—Base price, $9.50 per 100 lb., f.o.b. plant.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick, and Zirkite are unchanged from Aug. 9 prices.

Iron Trade Dull But Steady

Pittsburgh, Aug. 12, 1924.—That the steel trade has recently swung around the turn is still more clearly seen this week, but it is plain also that the improvement is gradual.

Sheets are steadier by having settled to minimums in the range recently prevailing, with black at about 3.50c. and galvanized at about 4.60c., with blue annealed at 2.60c. to 2.70c. Automobile sheets have broken in the fortnight from 5.10c. to 4.75c., which they should have no difficulty in holding. Bars remain at 2.15c. and plates at 2.00c., except on small orders, and shapes are now 2.10c. rather than 2.15c.

The Steel Corporation's unfilled tonnage decreased by 75,433 tons in July, against 365,584 tons in June and 580,358 tons in May.

Pig Iron—The market continues dull, but shows a better tone; Bessemer, $20; basic, $19; foundry, $19, Valley.

Connellsville Coke—The market is dull and steady, the trade simply awaiting improvement in consumption. Furnace, $3; foundry, $4@$4.50; heating, $2.60@$2.75; medium sulphur, $2.75@$2.85.

Company Reports

International Nickel Co.

The International Nickel Co., for the quarter ended June 30, 1924, reports a net profit of $359,699 after charges and depreciation, and all taxes. This compares with $204,802 in the corresponding quarter of 1923.

Income account for the quarter ended June 30, 1924, compares as follows:

	1924	1923	1922
Earnings	$794,777	$594,029	$189,648
Other income	50,878	52,355	31,089
Total increase	$845,655	$646,384	$220,737
Administration and general expenses	103,304	92,248	85,730
Federal taxes	60,658	38,237	10,457
Net income	$681,693	$515,899	$124,550
Depreciation and depletion	321,994	311,097	184,125
Profit	$359,699	$204,802	(*a*) $59,575
Preferred dividends	133,689	133,689	133,689
Surplus	$226,010	$71,113	(*b*) $193,264

(*a*) Loss. (*b*) Deficit.

The consolidated balance sheet of the International Nickel Co., as of June 30, 1924, compares as follows:

Assets

	1924	1923	1922
Property	$50,634,024	$51,181,274	$50,481,561
Investments	234,572	571,770	560,409
Inventories	7,723,238	5,926,279	7,908,012
Accounts receivable	1,944,093	1,646,161	828,091
Advances	91,704	174,781	184,749
Call loans	500,000	1,250,000	1,013,000
Government securities	1,106,569	100,000	100,000
Cash	849,789	1,393,895	1,032,491
Totals	$63,083,989	$62,244,160	$62,108,313

Liabilities

Preferred stock	$8,912,600	$8,912,600	$8,912,600
Common stock	41,834,600	41,834,600	41,834,600
Accounts payable (*a*)	775,173	723,307	537,737
Preferred dividends payable	133,689	133,689	133,689
Interest and contingent reserve	452,076	532,183	867,111
Profit and loss surplus	10,975,851	10,107,781	9,822,576
Totals	$63,083,989	$62,244,160	$62,108,313

(*a*) Includes tax reserve.

Shattuck Arizona Copper Co.

The following is a report of the results of operations of Shattuck Arizona Copper Co. for the quarter ended June 30, 1924:

Copper ore was mined at the rate of approximately 60 tons per working day; lead ore at the rate of approximately 120 tons per day. The present low price of copper metal, and labor conditions, will not allow the shipment of lower-grade ores at a profit. The company was limited to shipments of 100 tons of lead ore per day by the smelter.

The total exploration and development for the quarter was 1,444½ feet. The cost of development per dry ton of copper ore treated was $3.10. The average cost per foot of advance was $9.93.

Exploratory work on the surface tunnel level has opened up very promising ground carrying small values in copper and silver and work is now being done on the 100 level to prospect underneath the favorable territory opened up on the surface tunnel level.

The production and costs per pound for the second quarter are as follows:

	Copper	Lead
Dry tons mined	4,399.70	9,181.23
Dry tons treated	4,448.77	9,296.44
Pounds copper recovered	674,128.00	.....
Pounds lead recovered	.....	1,384,109.00
Ounces silver recovered	17,437.00	77,735.00
Ounces gold recovered	77.67	844.90
Net operating cost per pound, cents	10.42	6.38

The net operating cost is for delivered metal after credit for precious metal byproducts, but before charge for depletion and deferred development expense.

Earnings

The result in earnings for the quarter were as follows:

Refined copper at 12½c. per pound		$84,266.00
Gold and silver (copper ores)		12,015.60
Gross value of lead ores		178,140.83
Interest		8,979.51
Dividends		170.00
Total		$283,571.94
Operating expense, copper	$82,259.10	
Operating expense, lead	155,584.11	
Administrative expense	4,502.33	
		242,345.54
Net income, before depletion and deferred development		$41,226.40

The results on lead are based on actual smelter settlements. The earnings on copper are obtained by inventorying copper at 12½c. per lb., silver at 60c., and gold at $20 per ounce.

No copper metal was sold during the quarter.

Nevada Consolidated Copper Co.

A statement of the operations of the Nevada Consolidated Copper Co. for the second quarter of 1924 reports that production of copper for the quarter was 17,183,089 lb., compared with 18,334,857 lb. for the preceding quarterly period. The following tables show net production by months for the current quarter and the preceding quarterly period:

Second Quarter, 1924	Pounds	First Quarter, 1924	Pounds
April	5,707,574	January	6,196,556
May	5,735,811	February	6,435,134
June	5,739,704	March	5,703,167
Total	17,183,089	Total	18,334,857

A total of 840,000 tons dry weight of Nevada Consolidate ore, averaging 1.23 per cent copper, was milled, and 6,287 dry tons of Ruth Mine direct smelting ore, averaging 7.383 per cent copper, was shipped to the smelter. Besides the company ores received, 3,594 dry tons of direct-smelting custom ores were received and treated at the smelter.

The cost of production, including charges for depreciation of plant and equipment and all fixed and general expenses and after credit for gold and silver values and miscellaneous earnings, was 11.36c. per lb. of copper produced, compared with 11.31c. per lb. for the preceding quarterly period.

The financial outcome of operation is shown in the summary statement submitted below, set out in comparison with the preceding quarter:

	Second Quarter 1924	First Quarter 1924
Operating gain from production of copper	$229,257.33	$199,610.82
Value gold and silver and miscellaneous earnings	177,093.71	213,849.34
Nevada Northern Railway Co. dividend	100,000.00	150,000.00
Total income	$506,351.04	$563,460.16
Plant and equipment depreciation	150,429.72	150,429.72
Increase in earned surplus	$355,921.32	$413,030.44

Earnings as above are based upon an average carrying price of 12.855c. per lb. of copper, compared with 12.747c. for the previous quarter.

The construction program has advanced to practical completion in the concentrator to the full capacity required for the immediate future. The capacity of the mill is now in excess of that of the old plant before it was destroyed. Power-plant improvements were also completed during the quarter, leaving only relatively unimportant installation unfinished. Expenditures for construction and improvements will therefore in the near future be incidental, compared with those of the last two years.

Butte & Superior Mining Co.

The report of the Butte & Superior Mining Co. for the quarter ended June 30, 1924, shows a deficit of $58,070 after expenses, taxes, and depreciation, but before depletion. This compares with a surplus of $21,580 in the previous quarter and a deficit of $60,085 in the second quarter of 1923. For six months the deficit was $36,490, against a surplus of $42,742 in the same period of 1923.

The statement for the quarter ended June 30, 1924, compares as follows:

	1924	1923	1922
Net value of metal in concentrates	$612,631	$898,992	$651,077
Miscellaneous income	9,898	20,043	32,002
Total income	$622,529	$919,035	$683,079
Expenses, depreciation, and taxes	680,599	(a) 979,120	749,924
(b) Deficit	$58,070	$60,085	$66,845

(a) Includes shutdown expenses. (b) Before depletion.

Income account for the six months ended June 30, 1924, as compiled from quarterly reports, compares as follows:

	1924	1923
Net value metal in concentrates	$1,454,176	.....
Miscellaneous income	20,357	.....
Total income	$1,474,533	$2,017,180
Expenses, taxes, and depreciation	1,511,023	(c) 1,974,438
Deficit (a)	$36,490	(b) $42,742

(a) Before depletion. (b) Surplus. (c) Includes shutdown expenses.

During the second quarter of 1924 the Butte & Superior Mining Co. produced 13,840,261 lb. of zinc and 3,056,875 lb. of copper, against 18,739,003 lb. of zinc and 3,394,660 lb. of copper in the first quarter. The decrease in earnings was due mainly to a decline in the average price of zinc to 5.89c. a pound in the second quarter, compared with 6.54c. in the first quarter. The copper price was 12.74c., compared with 12.86c. in the first quarter.

Silver produced in the second quarter amounted to 263,351 oz. from zinc ores and 226,287 from copper ores, compared with 327,331 and 254,721 oz. respectively in the first quarter. The company, in the second quarter, obtained 65.48c. an ounce for silver in zinc ores and 65.47c. for silver in copper ores. These prices compare with 63.87 and 63.84c. respectively in the first quarter.

The company mined 72,236 tons of zinc ore and 37,241 tons of copper ore in the second quarter, compared with 86,773 and 44,275 in the first quarter. Zinc ore averaged 9.331 per cent and 3.65 oz. silver a ton, and the copper ore 4.10 per cent copper and 6.08 oz. silver. Zinc ore in the first quarter averaged 10.793 per cent zinc and 3.77 oz. of silver, and copper ore 3.84 per cent copper and 5.75 oz. silver.

Utah Copper Co.

A statement of the affairs of the Utah Copper Co. for the second quarter of the fiscal and calendar year 1924 states that the total net production of copper from all sources was 52,559,180 lb., a decrease of 2,890,096 lb., compared with the output of the previous quarter:

Second Quarter, 1924	Pounds	First Quarter, 1924	Pounds
April	17,533,850	January	18,627,523
May	17,564,550	February	19,365,523
June	17,460,780	March	17,456,230
Total	52,559,180	Total	55,449,276

During the quarter the Arthur plant treated 1,327,000 dry tons of ore and the Magna plant 1,526,000 dry tons, a total for both plants of 2,853,000 dry tons.

The average grade and ore treated at the mills was 1.09 per cent copper and the average mill recovery of copper in the form of concentrates was 88 per cent of that contained in the ore, compared with 1.08 per cent copper and 83 per cent recovery, respectively, for the previous quarter.

The average cost per pound of net copper produced, including depreciation of plant and equipment and all fixed and general expenses and after crediting gold, silver, and miscellaneous earnings, was 8.6c., compared with 9.12c. for the preceding quarter, computed on the same basis. The value of gold and silver recovered and the miscellaneous earnings amounted to 1.08c. per lb. of copper, compared with 1.08c. for the previous quarter.

The following tabulation shows the financial results of the company's operation for the quarter as compared with the previous quarter:

	Second Quarter 1924	First Quarter 1924
Net profit from copper production	$1,956,007.81	$1,719,714.44
Miscellaneous income, including gold and silver	568,518.34	596,989.73
Bingham & Garfield Ry. Co. dividend	100,000.00	100,000.00
Total income	$2,624,526.15	$2,416,704.17
Depreciation	288,946.96	284,459.89
To surplus	$2,335,579.19	$2,132,244.28

Earnings for the second quarter are computed on the basis of 12.853c. per lb. carrying price of copper, compared with 12.782c. for the first quarter of 1924.

A quarterly distribution to stockholders of $1 per share was made on June 30, 1924, and amounted to $1,624,490.

The total capping removed during the quarter was 1,737,666 cu.yd., compared with 904,000 cu.yd. for the previous quarter.

The ore-delivery department transported a total of 2,997,670 tons of ore, being an average of 32,941 tons per diem, compared with 3,433,487 tons and 37,731 tons, respectively, for the previous quarter.

New Jersey Zinc Co.

A statement of the New Jersey Zinc Co. for the quarter ended June 30, 1924, follows:

Income (including dividends from subsidiary companies) after deductions for expenses, taxes, maintenance, repairs, depreciation, depletion, and contingencies	$2,180,100.80
Deduct: Interest on first-mortgage bonds	40,000.00
Net income	$2,140,100.80
Deduct Dividend 2 per cent payable Aug. 9, 1924	981,632.00
Surplus for the quarter	$1,158,468.80

Record Gold Output in Ontario

Ontario's gold output for the first quarter of 1924 established a new record, exceeding that of 1922, the best previous year, by $1,060,407, according to the Ontario Department of Mines. Production was not hampered by power shortage, as in the last two years. Ample hydro-electric energy is now available, and other powers will be harnessed this year on the Quinze and Abitibi rivers to meet expanding needs. The Hollinger mine has worked up mill capacity to over 5,000 tons daily. At Kirkland Lake the Tough Oakes-Burnside mill will be reopened in the near future. The Lake Shore has enlarged its mill from 60 to 300 tons' daily capacity, and the Teck-Hughes has started a new central shaft. At Night Hawk Lake the Peninsular started milling early in the new year. Details of production follow:

Source	Gold Recovery Ounces	Gold Recovery Value	Silver Recovery Ounces	Silver Recovery Value	Total Value Including Exchange
Porcupine					
Clifton-Porcupine	254	$5,255	24	$15	$5,270
Dome	49,702	1,027,426	6,767	4,331	1,031,757
Hollinger Consolidated	142,560	2,949,107	24,402	16,785	3,039,406
McIntyre	42,547	879,759	8,276	5,292	899,765
Vipond Consolidated	7,897	163,237	655	416	167,931
Totals	242,960	$5,024,784	42,124	$26,839	$5,144,129
Kirkland Lake					
Kirkland Lake	1,443	29,825	231	147	29,972
Lake Shore	6,752	139,567	455	290	143,637
Teck-Hughes	13,209	273,064	1,214	773	281,365
Wright-Hargreaves	9,288	191,991	1,483	941	196,045
Totals	30,692	$634,447	3,383	$2,151	$651,019
Miscellaneous					
Argonaut	2,086	43,127	35	22	43,150
Porcupine Peninsula	1,375	28,411	303	190	28,601
North McDonald	6	125	1	1	126
Nickel-copper refining	250	4,988	.....	.....	4,988
Totals	3,717	$76,651	339	$213	$76,865
Grand totals	277,369	$5,735,882	45,846	$29,203	$5,872,013

Mining Stocks

Week Ended August 9, 1924

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb	...	...	*10	...	...
Anaconda	New York	37	35⅛	36	De.15, Ja.21, Q	0.75
Arcadian Consol.	Boston	1⅞	1⅝	1⅝	...	...
Ariz. Com'l.	Boston	11⅛	11	11⅛	Jy.19, Jy.31	0.50
Calaveras	N. Y. Curb	...	...	1⅛	...	...
Calumet & Arizona	Boston	52½	51¼	51¼	Jn. 6, Ju. 23 Q	0.50
Cal. & Hecla (New)	Boston	18	17½	17½	My. 31, Jn. 10	0.50
Canario Copper	N. Y. Curb	3⅛	3⅛	3⅛	...	...
Cerro de Pasco	New York	46¾	45	46⅛	Jy. 17, Au. 1	1.00
Chile Copper	New York	32⅞	31⅜	32⅛	Se.3, Se.29, Q	0.62½
Chino	New York	22½	20¾	21	Sept., 1920,	0.37½
Con. Coppermines	N. Y. Curb	3 7/16	3	3⅛	...	...
Copper Range	Boston	28	26½	26½	May, 1923	1.00
Crystal Copper	Boston Curb	*95	*73	*95	...	...
Davis-Daly	Boston	*45	*45	*45	Mar., 1920	0.25
East Butte	Boston	4⅝	4⅛	4⅛	Dec., 1919	0.50
First National	Boston Curb	...	...	*38	Feb., 1919,	0.15
Franklin	Boston	...	...	*70	...	...
Gadsden Copper	Boston Curb	*80	*80	*80	...	...
Granby Consol.	New York	17⅛	16⅞	17⅛	May, 1919	1.25
Greene-Cananea	New York	16	15⅝	15⅝	Nov. 1920	0.50
Hancock	Boston	1¼	1¼	1¼	...	...
Howe Sound	N. Y. Curb	2⅞	2⅛	2⅛	Ap.1, Ap.15, Q	0.05
Inspiration Consol.	New York	27⅛	25⅞	26⅞	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb	3⅛	3⅛	3⅛	May, 1923	0.15
Isle Royale	Boston	18	16⅞	18	Se. 1, Se. 15.	0.50
Jerome Verde Dev.	N. Y. Curb	1	*95	*95	...	...
Jib Consol	N. Y. Curb	*80	*71	*74	...	...
Kennecott	New York	47⅜	45⅝	47⅜	Jn.6, Jy 1,Q	0.75
Keweenaw	Boston	...	...	1	...	...
Lake Copper	Boston	2½	2½	2½	...	...
Magma Copper	New York	36	32⅝	33⅞	Jan., 1919	0.50
Mason Valley	N. Y. Curb	2⅛	1⅞	2	...	...
Mass Consolidated	Boston	1⅛	1⅛	1⅛	Nov., 19..	1.00
Miami Copper	New York	24	23⅛	23⅜	Au.1, Au.15, Q	0.15
Mohawk	Boston	35	33⅛	33⅛	Se. 22, Oc. ..	1.00
Mother Lode Coa.	New York	8⅝	8	8⅛	Jn.13, Jn.30	0.37½
Nevada Consol.	New York	14	13⅛	13⅝	Sept., 1920,	0.25
New Cornelia	Boston	22⅛	21⅛	21⅜	Au.8, Au.25,	0.25
New Dominion	N. Y. Curb	...	...	2⅛	...	...
North Butte	Boston	5	4⅞	5	Oct., 1918,	0.25
Ohio Copper	N. Y. Curb	1 1/16	1	1	...	...
Old Dominion	Boston	26	23	24	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†103	†101	...	Jn 21, Jy.2 Q	1.00
Quincy	Boston	24½	23½	23½	Mar., 1920	1.00
Ray Consolidated	New York	13⅛	12⅛	12⅛	Dec., 1920	0.25
Ray Hercules	N. Y. Curb	*15	*15	*15	...	...
St. Mary's Min. Ld.	Boston	37⅛	35⅛	35⅛	Ap.22, My.20	3.00
Seneca Copper	New York	2⅛	2	2	...	...
Shannon	Boston	*75	*75	*75	Nov., 1917	0.25
Shattuck Arizona	New York	7⅛	7⅛	7⅛	Jan., 1920	0.25
Superior & Boston	Boston	1	*95	*95	...	...
Tenn. C. & C. cfs.	New York	8⅜	8⅛	8⅛	De.31, Ja.15, Q	0.25
United Verde Ex	N. Y. Curb	29	27⅛	28	Jy.3, Au.1	0.50
Utah Copper	New York	81⅛	79⅛	79⅝	Jn.13, Jn.30,	1.00
Utah Metal & T.	Boston	40	30	30	Dec., 1917	0.30
Victoria	Boston	*75	*75	*75	...	...
Walker Mining	N. Y. Curb	3⅛	3⅛	3⅛	...	...
Winona	Boston	*50	*50	*50	...	...
NICKEL-COPPER						
Internat. Nickel	New York	19⅜	17⅝	17⅞	Jy.17, Au.1, Q	1.50
Internat. Nickel pfd.	New York	88	87	88	Jy.17, Au.1, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	4	3⅛	3⅞	...	...
National Lead	New York	161	146	161	Se.12, Se.30, Q	2.00
National Lead pfd.	New York	117	116⅞	117	Au. 22, Se. 15, Q	1.75
St. Joseph Lead	New York	29	28⅞	28⅝	Se. 9, Se.20	0.50
ZINC						
Am. Z. L. & S.	New York	8⅞	8⅛	8⅛	May, 1920	1.00
Am. Z. L. & S. pfd.	New York	29	28	28½	Nov., 1920	1.50
Butte C. & Z.	New York	5⅜	5⅛	5⅛	Mar., 1922	0.50
Butte & Superior	New York	17⅛	16⅛	16⅛	Je.15, Je. 30, Q	0.50
Callahan Zn-Ld.	New York	4⅛	3⅞	4	Dec., 1920	0.50
New Jersey Zn.	N. Y. Curb	155⅛	148	155⅛	May 10, 1924	2.00
United Zinc	N. Y. Curb	*25	*25	*25	...	...
Yellow Pine	Los Angeles	65	65	65	June, 1924	0.08
SILVER						
Alvarado	N. Y. Curb	*99	*99	*99	...	...
Beaver Consol.	Toronto	*14½	*14	*14½	May, 1920	0.03
Castle-Trethewey	Toronto	*79	*77	*79	...	...
Coniagas	Toronto	1.40	1.25	1.30	Ap.20, My.1	0.02½
Crown Reserve	Toronto	*54	*53½	*53½	Jan., 1917	0.05
Keeley	Toronto	2.29	2.26	2.29	...	...
Kerr Lake	N. Y. Curb	2	1⅞	2	Ap.1, Ap.15, Q	0.12
La Rose	Toronto	*8	*7	*8	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	1.35	1.30	1.35	...	...
McKinley-Dar.-Sav.	Toronto	*11½	*11½	*11½	Oct., 1920	0.03
Mining Corp. Can.	Toronto	2.45	2.40	2.45	Sept., 1919	0.12½
Nipissing	N. Y. Curb	6⅛	6	6	Jn.30, Jy.21, Q	0.15
Ontario Silver	New York	5⅜	5⅛	5⅜	Jan., 1919	0.50
Temiskaming	Toronto	*19	*18½	*18½	Jan., 1920	0.40
GOLD						
Alaska Gold	New York	15	12⅛	12⅛	...	...
Alaska Juneau	New York	1⅛	1	1	...	...
Argonaut	Toronto	*38	*37	*37	...	...

Stock	Exch.	High	Low	Last		Last Div.
Carson Hill	Boston	1⅛	1⅛	1⅛	...	...
Cresson Consol. G.	N. Y. Curb	3⅜	3⅛	3 1/16	Jn.30, Jy.10, Q	0.10
Dome Mines	New York	15⅞	15½	15⅞	Jn.26, Jy 21, Q	0.50
Golden Cycle	Colo. Springs	1.32	1.32	1.32	My.31, Jn.10 Q	0.03
Hollinger Consol.	Toronto	13.89	13.85	13.85	Jy.24, Au.11, M	0.05
Homestake Mining	New York	41⅞	41⅛	41⅞	Au.2, Au.25, M	0.50
Kirkland Lake	Toronto	*19⅛	*19	*19⅛	...	...
Lake Shore	Toronto	3.95	3.95	3.95	Se.1, Se.15, Q	0.05
McIntyre-Porcupine	New York	15⅞	15⅛	15⅞	Au. 1, Se. 1,	0.25
Newray	Toronto	*22	*20½	*22	...	...
Portland	Colo. Springs	53	52	53	Oct., 1920	0.01
Teck-Hughes	Toronto	1.25	1.21	1.25	...	...
Tom Reed	Los Angeles	31	28	28	Dec., 1919	0.02
Tough-Oakes	Toronto	*59	*57½	*59	...	...
United Eastern	N. Y. Curb	...	...	*45	Jy 18, Jy.31, Q	0.05
Vipond Cons.	Toronto	1.03	1.02	1.03	...	...
Wright-Hargreaves	Toronto	3.70	3.63	3.70	Jn.16, Jy. 1, Q	0.02½
GOLD AND SILVER						
Black Oak	N. Y. Curb	*98	*91	*98	...	...
Con. Cortez	N. Y. Curb	*18	*14	*16	...	...
Con. Virginia	San Francisco	3½	2½	3½	...	...
Continental Mines	N. Y. Curb	...	...	2½	...	...
Dolores Esperanza	N. Y. Curb	*55	*53	*54	Jy. 1, Jy. 10 Q	0.05
Premier Gold	N. Y. Curb	2 1/16	2	2	Jn.19, Jy.2	0.08
Tonopah Belmont	N. Y. Curb	*64	*61	*62	Apr., 1923	0.05
Tonopah Divide	N. Y. Curb	...	...	*27	Se.22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	2⅛	2 1/16	2⅛	Jn. 10, Jy. 1	0.05
Tonopah Mining	N. Y. Curb	2	1 15/16	1 15/16	Ap. 6, Ap. 21	0.07½
Unity Gold	N. Y. Curb	1	*90	*90	...	...
West End Consol.	N. Y. Curb	*53	*50	*50	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	...	...	*50	June, 1918	0.02
SILVER-LEAD						
Ahumada	Boston Curb	6⅛	6	6	Jn.16, Jy. 2, X	0.15
Bingham Mines	Boston	...	...	16	Sept., 1919	0.25
Cardiff M. & M.	Salt Lake	*81	*75	*80	Dec., 1920	0.15
Chief Consol.	Boston Curb	2⅜	2⅛	2⅛	Ap 19, My.1, Q	0.10
Columbus Rexall	Salt Lake	17⅛	16	16	Aug., 1920	0.03
Consol. M. & S.	Montreal	39⅛	38	38⅛	Jn 30, Jy.15	0.75
Daly Mining	Salt Lake	...	...	2.25	July, 1920	0.10
Erupcion	Boston Curb	2⅛	2⅛	2⅛	Jn. 16, Jy.2, X	0.15
Federal M. & S.	New York	...	...	10⅛	Jan., 1909	1.50
Federal M. & S. pfd.	New York	48⅜	47⅛	47⅛	My.26, Jn.15, Q.	1.75
Florence Silver	Spokane	9.25	8.75	8.75	Apr., 1919, QX	0.01
Hecla Mining	New York	9	9	9	My.15, Jn.15,	0.25
Iron Blossom Con.	N. Y. Curb	*21	*20	*21	Oct., 1923	0.02
Marsh Mines	N. Y. Curb	...	...	*5	June, 1921	0.02½
Park City	Salt Lake	4.00	4.00	4.00	Jn.14, Jy.1,	0.15
Park Utah	N. Y. Curb	...	...	3⅛	Mc.15, Ap.1	0.15
Prince Consol.	Salt Lake	*7	*7	*7	Nov., 1917	0.02
Silver King	N. Y. Curb	...	...	*75	Jn.20, Jy.1,	0.15
Silversmith	Spokane	*33½	*33	*33	Jy.1, Jy. 10,	0.01
Tamarack-Custer	Spokane	1.50	1.47	1.49	Jn 25, Jn.30,	0.02
Tintic Standard	Salt Lake	5.65	5.50	5.60	Jy.28, '24, X	0.25
Utah-Apex	Boston	2⅜	2⅛	2⅛	June, 1923,	0.50
IRON						
Bethlehem Steel	New York	44⅛	43⅛	43⅛	Jn.1, Jy.1, Q	1.25
Char. Iron	Detroit	...	...	*50	...	...
Char. Iron pfd.	Detroit	...	...	¾	...	...
Colorado Fuel & Iron	New York	54¼	50⅜	51⅛	Au. 11, Au. 25 Q	2.00
Col. Fuel & Iron pfd.	New York	...	...	102	Feb., 1923	2.00
Gt. North'n Iron Ore	New York	31⅛	29⅛	29⅛	De.10, De.27	2.00
Inland Steel	N. Y. Curb	....	....	46	Au.15, Se.1 Q	0.62½
Mesabi Iron	N. Y. Curb	....	....	2⅛	...	...
Replogle Steel	New York	13	11⅞	11⅞	...	...
Republic I. & S.	New York	49⅜	47	47	May, 1921	1.50
Republic I. & S. pfd.	New York	87⅛	87	87⅛	Se.15, Oc.1, Q	1.75
Sloss-Sheffield S.&I.	New York	67⅛	65⅛	66	Jn.6, Jn.20, Q	1.50
Sloss-Shef. S.&I.pfd.	New York	...	...	87	Jn.18, Jy.2, Q	1.75
U. S. Steel	New York	110	106⅛	107⅛	Se.1, Se.29 QX	1.75
U. S. Steel pfd.	New York	121⅜	121⅛	121⅛	Au. 5, Au. 30 Q	1.75
Virginia I. C. & C.	New York	37⅛	37⅛	37⅛	De.15, Ja. 2	1.50
Virginia I.C.&C.pfd.	New York	75	75	75	Jn.17, Jy.1	2.50
VANADIUM						
Vanadium Corp.	New York	25⅞	23⅛	23⅛	Jan., 1921	1.00
ARSENIC						
Western Utah Copper	N. Y. Curb	...	...	*17	...	...
ASBESTOS						
Asbestos Corp.	Montreal	25	24	24	Se.29, Oc.15 Q	1.00
Asbestos Corp. pfd.	Montreal	...	...	59	Jy.1, Jy.16, Q	1.50
SULPHUR						
Freeport Texas	New York	9⅜	8⅜	8⅜	Nov., 1919,	1.00
Texas Gulf	New York	75¼	72⅛	74⅛	My.31, Jn.14 QX	1.75
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	4	3⅞	4	...	...
MINING, SMELTING AND REFINING						
Amer. Metal	New York	47	45⅛	45⅛	Au. 18, Se. 2 Q	0.75
Amer. Metal pfd.	New York	...	...	112	Au.20, Se. 2, Q	1.75
Amer. Sm. & Ref.	New York	70⅜	68⅜	69⅛	Jy.11, Au. 1, Q	1.25
Amer.Sm.&Ref.pfd.	New York	104	102⅛	102⅛	Jy.11, Au. 1,	1.25
U. S. Sm. R. & M.	New York	31⅛	28⅛	29⅛	Jan., 1921,	0.50
U. S. Sm. R.&M.pfd.	New York	45	45	45	Jy.7, Jy.15 Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Colorado Springs, Colorado Springs Stock Exchange.